Engineering Library

EDITORIAL

'ELECTRICAL Prosperity Week' commences December 2 and closes December 9. We are becoming so accustomed to depending on some application of electricity during every minute of the twenty-four hours that we are apt to forget that most of these applications were unknown only a few years ago. If there were no other reason, this alone would be sufficient justification for setting aside one week every year as a reminder.

SURVEYS for a deep-water canal from the head of Suisun bay to Sacramento have been commenced. By taking advantage of several sloughs along the line between the two places, it is believed that a canal of sufficient depth for ocean-going vessels can be constructed for a reasonable amount. Such a canal would be more direct than the Sacramento river itself and would probably be cheaper to maintain than even the comparatively shallow channel now provided by the river, since both flood-waters and mining debris could be excluded from it.

LEASING of unoccupied land, in areas temporarily withdrawn for reclamation purposes, to stockmen and others is no longer permitted by the Federal government. The first step in this direction was made when the Controller of the Treasury ruled that money derived from such leasing could not be paid into the reclamation fund, but must go into the general fund. The Department of the Interior has now ruled that land withdrawn under the reclamation act, but not yet incorporated in any approved project, cannot be leased at all. The result is that the land may remain idle for years, without any real reason therefor. This is a condition that should be corrected by Congress at the earliest possible moment.

THE eight-hour day is to be the rule for practically all employees of the Standard Oil Company of California on and after December 15. The other Standard Oil companies have not signified their intention of following this example. The new rule will necessitate three shifts on drilling and pumping wells, pipe-lines, and other activities where continuous operation is required. Since wages are to continue the same, it seems probable that the other companies will be obliged to follow the Standard's example or else raise the wages of the men now working from nine to twelve hours per day. The Shell Oil Company has adopted the eight-hour day for its refinery at Martinez. While all this is gratifying to the employees affected, it must result in increasing the cost of production of both crude-oil and refined products. This increased cost must be borne eventually by the consumer.

THE result of the examinations held in August for provisional appointment to the grade of second lieutenant in the United States Army has recently been announced. There are 1600 vacancies in this grade to be filled because of the increase in the army authorized by the National Defense Act passed at the recent session of Congress. Only 425 passed the examination, of whom 155 are civilians. The fact that it seems to be difficult to obtain enough officers for the army on a peace footing, makes it particularly important that all those who are qualified to join the Officers' Reserve Corps should endeavor to make arrangements to do so and thus prepare for the possibility of their services being needed in time of war.

COMPLETE Federal regulation of all railroad matters may perhaps result from the turmoil resulting from the threatened strike last summer. The Congressional inquiry now being conducted will undoubtedly consider this question. In fact, the railroad companies are advocating Federal regulation in presenting their side of the case. No one now questions the necessity of sane government-regulation of railroads as well as other public-service corporations, but a great deal of regulation of railroads has not been sane. Even where the regulating commissions of adjoining States have meant well, they have frequently promulgated regulations which were contradictory, and troublesome for the railroads to observe. It was not so very long ago that it was possible when making a transcontinental trip to keep track of the crossing of State lines by observing whether or not the public drinking-cup was in its accustomed place below the ice-water tank. Other variations in State regulations, while less noticeable to the traveling-public, are a cause of much greater inconvenience to the railroads. To render good service to the public and to give an adequate return to security-holders are the two principal objects of railway management. Both of these objects can be accomplished better when there is one National regulating body instead of one National and forty-eight State commissions.

OPPOSITION to the extended use of water-meters at Portland, Oregon, was discussed in our columns some months ago. We now have to record the surprising fact that similar opposition has been aroused in San Francisco to this simple matter of business procedure. This attitude is less defensible at San Francisco than at Portland. At Portland, the actual supply at the intake is abundant for many years to come. To provide excessive amounts of water for wasteful consumers is

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merely a matter of constructing a few miles of additional supply-main at comparatively small expense, in fact, not much greater than the cost of installation of meters. San Francisco, on the other hand, is living uncomfortably close to the margin of its water-income all the time, with the prospect of a serious shortage if there is a dry year before the Calaveras dam and conduit is completed. An amusing feature of the discussion has been the use of the old argument of the possibility of unsanitary conditions resulting from restricted use of water following the introduction of meters, in spite of the fact that the minimum rate allows about 600 cubic feet of water per service per month. The protestants have managed to secure an order from the State Railroad Commission postponing until February the time when the meter-rates are to take effect. Meanwhile a comparison is to be made of the bills on the metered services computed by the old flat-rates and the new meter-rates. Should the revenue under the proposed rates be appreciably higher than under the present rates, a revision of rates will be required.

ONE of the most important obstacles to efficient government in American cities has been the prevailing rule prohibiting the appointment of non-residents to municipal offices. The directors of a private corporation will select the best available man for a position, no matter where he may happen to live, but the principle of free trade in brains has not made much headway in government employment. The primary qualification for even a civil-service position is usually one year's residence in the city. Recently, however, several cities have adopted charters with more liberal provisions regarding employment. The voters of San Jose, California, in particular, ratified a charter, providing for a city manager, not necessarily a resident of the city, and allowing him a large amount of freedom in the selection of his subordinate officers. Mr. Thomas H. Reed, Professor of Political Science at the University of California, and the author of several books upon the subject, was appointed to the position. In the few months since his appointment he has made a number of improvements in the administration of municipal affairs. But, on the other hand, he has appointed some non-residents to office in cases where there were no local men equally suitable, and has incurred the wrath of a number of adherents of the old inefficient system. A petition is being circulated for a special election to amend the charter in such a way as to prohibit the appointment of non-residents to municipal positions. It is not clear how this would affect either Mr. Reed or the men whom he has already appointed, since they are presumably residents at the present time, and the provision could hardly be made retroactive. It would, however, cripple further freedom of appointment. With the present law regarding initiative elections, it is highly probable that the matter will be brought to a vote. But while the people who will sign anything, added to those who have special reasons for keeping the municipal positions at home, may be sufficiently numerous to have an election called, we believe that a large majority of the voters of San Jose prefer efficiency to 'pork,' and that this retrogressive step will be defeated at the polls.

Irrigation by Pumping

In the early days of irrigation development, it was comparatively easy to divert part of the flow of a stream through a short ditch to some hitherto waste land. Even where the stream ran through the land in question, it was usually cheaper to have the point of diversion far enough up-stream to obtain a gravity flow, rather than to pump water directly from the channel. Pumps and engines were crude, and in many parts of the West there was no cheap fuel. Hydro-electric development was still to come. Some irrigating was done from artesian wells, but there are well authenticated cases where good farms were abandoned because the pressure in the artesian area had become so reduced that the water no longer came to the surface.

Gradually, however, the opportunities for inexpensive development of gravity-irrigation became exhausted. At the present time, a construction cost of $50 per acre is by no means unusual for a gravity project. While the value of irrigated land has increased with equal rapidity, this increase of construction cost causes the engineer and farmer to study carefully other methods of obtaining water. At the same time oil fuel and hydro-electric power have reduced the operating cost of a pumping system to such an extent that it is frequently little if any more than the cost of maintaining a long diversion canal, particularly when the comparative losses from evaporation are considered. Again there is much good land that cannot be irrigated by gravity at all, but which can be irrigated by pumping. Furthermore, water draining from higher irrigated lands may sometimes be pumped from the drainage channels to irrigate the lower land.

Pump-irrigation, like gravity-irrigation, began with individual effort, and it is probable there will always be a number of cases of individual owners pumping from wells or from streams too low to make gravity-irrigation possible. The tendency, as in the case of gravity-irrigation, has been toward combination, and there are many projects now being served either by corporations, or by co-operative associations. There are now three large irrigation-district systems under construction in California. Two of these, the Lindsay-Strathmore and the Terra Bella systems, are pumping projects, water being obtained from wells pumped by electric motors. The third, the Anderson-Cottonwood system is a gravity project, water being obtained from the Sacramento river. Bids are to be received this month for the construction of the first unit of the system of the West Side irrigation district near Tracy. This will be a pumping system, water being obtained from a branch of the San Joaquin river. It is noteworthy that while a number of individual owners use gas or oil-engines, hydro-electric power is the rule on nearly all of the larger projects.

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REVIEW OF THE MONTH

IMPROVEMENT of channel conditions on the Sacramento river as a result of the dredging now under way near Collinsville continues to be shown. During September 1914, the steamboat pilots experienced considerable difficulty in passing sandbars when the gauge at Sacramento read 4.2 feet. Recently, however, the same vessels were operated with ease when the gauge showed 3.7 feet.

RECONSTRUCTION of the Lower Otay dam, which failed last January, was assured on November 17, when the voters of San Diego approved a bond issue of $682,000 for this purpose. The new structure will be about the same height as the old dam, but instead of a rock fill with a steel and concrete core through the centre there will be a solid concrete arch-dam of gravity section. The spillway capacity will also be considerably larger.

THE indeterminate-franchise plan was successful in both Oakland and Berkeley at the recent election. These cities are now served by the same street-railway company operating under a large number of separate franchises with varying provisions. A general discussion of indeterminate franchises appeared in WESTERN ENGINEERING for August. The present plan, which is in the form of a charter amendment, will enable the city council by following a prescribed procedure to grant franchises of an indeterminate length in place of those now in existence. A valuation of the company property under each franchise is to be made by the State Railroad Commission. After operating and maintenance costs, depreciation, interest, etc., have been deducted from the gross receipts, the remainder is to be divided between the city and the company, not less than 55% going to the city. A board of control composed of one representative of the city and one of the company is to direct the affairs of the street-railroad, an arbiter being appointed in case of a disagreement. The city may take over the franchise and equipment at any time upon payment of the valuation named in the franchise, or the city may arrange to have another private company take charge upon payment of the stated amount. Similar regulations are to apply in the case of franchises for new lines. The indeterminate franchise has been in use in Chicago and Kansas City for several years, but this is the first time that it has been proposed on the Pacific Coast.

COMPLETION of the State highway system through California is assured by the passage of the additional bond issue of $15,000,000. No detailed figures are available at this writing, but it would appear that the opposition was negligible throughout the State. When the measure was passed by the legislature nearly two years ago, it was estimated that $12,000,000 would be required to complete the main State highway system connecting the various county-seats as provided under the original Act of 1909. The remaining $3,000,000 was to be used in connection with county funds for the construction of the following laterals: coast near Eureka to Sacramento valley, Gilroy *via* Pacheco pass to San Joaquin valley, Mariposa to Yosemite valley, Hanford *via* Coalinga to Salinas valley, Bakersfield to San Luis Obispo, San Bernardino to Barstow, Los Angeles to Antelope, San Bernardino to Yuma *via* Brawley and El Centro. Since the bond-issue was passed by the legislature, the 'Federal Aid Road Bill' has been passed by Congress. This provides for the expenditure of $2,300,000 of Federal funds in the State at large during the next five years, and of $140,000 per year for ten years in the National Forests or on connecting roads. It is safe to assume that nearly all of the general fund and a large part of the forest fund will be available for use in co-operation with the State highway projects. In fact, arrangements have already been made to use the money from the general fund for this year on State highway contracts now under way. This additional amount will, no doubt, more than compensate for any increase of cost of materials and labor since the estimates were made. In a few years California should have the finest highways of any State in the country. The less important highway measure, providing for the remission of interest on the highway bonds where expenditures within a single county are unusually large, also received a decisive majority.

PANAMA CANAL conditions are discussed in the annual report of Governor Goethals. The slides of the past year or two have caused several persons with better intentions than information to advance surprising opinions regarding the cause of the unsatisfactory conditions. Prominent among these is the theory that the entire bottom of Culebra cut is a vast bog, from which material will be forced to the surface for an indefinite period. Another theory is that subterranean gases are in some way responsible for all the trouble. The report, however, shows that the total length of the Canal affected by slides, both at Culebra and Cucaracha, is only 4800 feet, or about one-tenth of the length of the Culebra cut. Even here the canal-prism was excavated through rock and indurated material so hard that it required blasting, and the gases, if present, obstinately refused to come to the surface. A comparatively small part of the sliding

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has been caused by material standing at too steep a slope, seeking the angle of repose. In general, however, the unstable conditions result from deformation of underlying strata from which some of the lateral support has been removed by the excavation of the Canal. There is a limit to the amount that will slide into the canal-prism because of these conditions, and when this amount has been removed, stable conditions will be obtained. There is no foundation for the belief that the Canal is a failure or that it will eventually be necessary to abandon it and construct a canal by way of Nicaragua.

OIL PRODUCTION in California continues to lag behind consumption. The reduction in stocks during October was 930,000 barrels, which is about the average that has been maintained since the beginning of the year. If this rate should continue, it would wipe out the entire amount of storage in four years. While this is hardly to be expected, it is noteworthy that while there are approximately twice as many wells drilling as there were a year ago, the total production of the State, after allowing for wells 'shut-in' at that time, is little, if any, larger. There are a number of 'wildcat' wells now drilling, but any large addition to the proved territory does not seem probable. The general market conditions have justified a recent increase of 5 cents per barrel in the prices paid for all grades of oil. The price of oil of 14 to 18 gravity is now 73 cents per barrel at the well.

IT IS PROBABLE that the world's supply of petroleum will be less than the demand for some years to come. It should be remembered that the principal oilfields of Europe, in Galicia and Rumania, are in the eastern war-zone, and that each retreating army has, undoubtedly, availed itself of the opportunity to do as much damage as possible to wells and other equipment. It will be years, if ever, before these fields can reach the rate of production before the War. In view of all these conditions, the importance of real conservation of our petroleum resources becomes increasingly evident. Crude oil should not be used for fuel without at least 'topping' it to remove the volatile constituents. It is also to be hoped that the passage of some constructive water-power legislation at the coming session of Congress, together with the increased price of fuel-oil, will result in the substitution of hydro-electric for steam-electric power wherever possible.

MEANWHILE, the Department of Justice seems to be the agency of the Federal government that is most directly concerned with petroleum in California, with the Navy Department a close second. Mr. Franklin Roosevelt, Assistant Secretary of the Navy, has recently delivered an address before the American Mining Congress, claiming in effect that unpatented oil-land must be retained by the Government for the benefit of the Navy. Such a claim would be more reasonable if all the land in the oilfields were unpatented. As a matter of fact, however, there are large tracts of land to which the title is undisputed, and upon which there are many producing wells, directly adjacent to the unpatented lands that are now the subject of litigation. As long as the wells on the patented land are pumped, there is no way to prevent the oil underlying the unpatented land from flowing toward them. Furthermore, prolonged suspension of operations in almost any part of the California oilfields would result in irreparable loss through water-infiltration. Proper leases with the option of purchase by the Government of any or all of the oil produced at a fixed price above the cost of production, would seem a better way to solve the Navy's fuel problem, and one that would probably be found more economical.

CONSTRUCTION of a 30-mile double-track railroad tunnel under the Cascade range in eastern Washington is advocated by General H. M. Chittenden, who originally suggested the plan in 1909, when apparently the time was not yet ripe. Three transcontinental lines—the Great Northern, Northern Pacific, and Chicago, Milwaukee & St. Paul—cross the Cascades on the way to Seattle and other Puget Sound points, at summit-elevations ranging from 2562 to 3375 feet. Tunnels are necessary in each case to obtain even these elevations. The proposed tunnel would have a summit-elevation of 1210 feet. The ruling grades on the present lines range from 1% to 2.2%, while the proposed tunnel-line would have a ruling grade of 0.6%. On the Great Northern Railroad alone, the total curvature in crossing the mountains is 6855°. Nearly as important as the saving in grade and curvature would be the improvement in other operating conditions and in maintenance. The road-beds on the present lines are mainly on steep slopes where snowslides and landslides are frequent. In addition, traffic is likely to be completely tied up for several days at a time during the winter. Besides the three railroads mentioned above, it is believed that the construction of such a tunnel would benefit the Union Pacific Railroad to a considerable extent.

THE proposed route for the tunnel is between Leavenworth and Skykomish, on the present line of the Great Northern railroad. Additional trackage would have to be constructed by the other railroads in order to reach the tunnel route. The tunnel would be more than twice as long as the Simplon tunnel, at present the longest in the world. The estimated cost, including interest during construction, is between $40,000,000 and $50,000,000, and it is believed that the benefits derived by the four railroads concerned, as well as the general public, would be sufficient to justify such an expenditure. When it is remembered that the Pennsylvania Railroad alone spent over $100,000,000 to accomplish a comparatively unimportant improvement in its method of entering New York, the figures are not so staggering as would appear at first sight. The estimated time for construction ranges from 13 years in case the tunnel is driven entirely from the portals, to 5½ years in case four shafts are used.

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DISCUSSION

Vague Descriptions of Land

The Editor:

Sir—The following is a copy of part of an amendment to the charter of the city of Los Angeles fixing the districts in which slaughter-houses may be maintained. This amendment was sent to the voters for approval, but no further information than that given on the leaflet was furnished. While the description of the tracts may be perfectly legal, it is apt to be a little confusing to one who does not happen to remember just which piece of land John Scheerer sold to John Cline some twenty or thirty years ago.

"Beginning at the point of intersection of the northerly line of the tract of land conveyed by John Scheerer to John Cline, by deed, recorded in Book 209, page 273 of Deeds, projected westerly, with the easterly line of the right of way of the Southern California Railway Co.; thence easterly along said projected line, to the northwesterly corner of the tract of land so conveyed to Cline; thence south 67 degrees east, 262.38 feet to a point in the westerly line of the strip of land sold by John Scheerer to C. W. Smith, trustee, by deed, recorded in Book 187, page 609 of Deeds; thence following the westerly line of said strip northerly, on a curve to the right that is concave, the north-west chord of which is north 17 degrees, 34 minutes east, 225 feet, and the radius of which is 842 feet, to a point where said chord intersects said curve, which point is the north-east corner of the tract of land conveyed by Charles J. and Libbie H. Haines to Cudahy Packing Co., by deed, recorded in Book 826, page 95 of Deeds; thence northerly, 237.80 feet, on a curve, the radius of which is 841.75 feet, the chord from which last named point bears north 1 degree, 40 minutes east, to a point of tangent and stake marked, "Southern California Railway Company's Prop."; thence north 6 degrees, 35 minutes west, along the right-of-way of the Southern California Railway Co., 893.90 feet, to a stake and corner of fence marking the southerly line of the land now or formerly belonging to O. M. Godfrey; thence south 80 degrees, 53 minutes west, along Godfrey's line and fence, 176.15 feet, to the north-east corner of the triangular piece of land secondly described in the deed to W. C. Nevin, trustee, recorded in Book 1251, page 145 of Deeds; thence south 13 degrees west, along the easterly line of said triangular piece of land described in said deed to W. G. Nevin, trustee, and along the westerly line of the piece of land described in the deed from W. G. Nevin, trustee, to Michael Cudahy, by deed, recorded in Book 1246, page 253 of Deeds, and along the easterly line of the lot of land first described in the deed to W. G. Nevin, trustee, 992.53 feet, more or less, to the point of beginning; being a part of the property now owned and occupied by the Cudahy Packing Company."

Few except the older residents would think to associate the Southern California Railway Co. with the Atchison, Topeka & Santa Fe Railroad.

H. K. Palmer.

Los Angeles, October 25.

[Vague descriptions of property such as the one given by our correspondent are only too common in all parts of the country. The established method of subdividing the public land, while faulty in some respects, has the great advantage of permitting simple and definite descriptions of any piece of land originally held by the Government. Even in the case in point it ought not to have been difficult to have referred the description at several points to some established street intersection. It might also be stated that the system which requires that a purely technical subject such as slaughter-house regulation be submitted to the entire body of voters, seems to be a case of direct legislation run wild.—Editor.]

Finishing concrete roads by dragging heavy belting across the surface has recently been tried in Wayne county, Michigan, where the method of using the belt is as follows: Three pieces of heavy belting about 10 in. wide and a few feet longer than the width of the road are used. The first is 'seesawed' across the road as soon as the template has been used. The second belt is used in a similar manner but not until water has just disappeared from the surface. After the concrete has stiffened somewhat, the third belt is run over the surface and leaves a fine-grained, coarse, gritty texture. On the Fremont-Port Clinton road in Ohio, contractors are using a strip of 8-ounce canvas 24 in. wide and 18 ft. long in much the same manner. Although the value of these methods has not been demonstrated beyond dispute, indications are that they will prove to be more economical and satisfactory than floating by hand.

The total of the world's merchant shipping on June 30, 1916, according to Lloyd's Register was 48,683,136 tons, against 49,089,552 tons on June 30, 1914, before the outbreak of the War, a net loss of 406,426 tons. The tonnage of American ships has increased from 5,368,194 to 6,148,861, or a gain of 780,667 tons. This has resulted mainly from changes of registry. The shipping of all other neutral nations has increased 46,352 tons. The shipping of the Entente allies has gained 269,740 tons, while shipping under German, Austrian, and Turkish flags is 1,503,215 tons less.

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The Maintenance of Roads

By WILLIAM F. COCKE*

Continuity and uniformity are essential to the maintenance of trans-State thoroughfares, and experience has demonstrated that the patrol system is the most economical and efficient means of securing these results. By continuity and uniformity I do not mean that the same type of surface should be used throughout the entire length of any road across a State, but that the several types of surface, best adapted to the several divisions of the road, should each be maintained for their full length in such a manner as to be kept up to standard efficiency throughout the entire year.

The practical application of the patrol system to through roads would mean that each road would be divided into sections of convenient length, depending on traffic conditions, but usually about ten miles, each section to be under the care of a patrolman. The patrolman would be provided with a horse and wagon and the necessary small tools. He would be expected to spend every working-day going over his section, opening drains, repairing small defects and adding new material to the surface where needed. The material required for repairing the surface should be stacked in piles along the road. On gravel, marl, and sand-clay roads the patrolman should be furnished with a long drag, and be authorized to hire an extra horse, to hitch beside the one furnished him, whenever necessary to drag any part of his section. The patrolmen should be under a division engineer, who should be responsible for their efficiency and for furnishing them with necessary material for maintenance. The division engineer should be required to keep accurate account of the cost of maintenance on each section under his supervision. His territory should be arranged so that he can inspect each section at least twice a month.

A county maintenance-system must provide for the upkeep of the roads radiating from the towns and shipping points, and also for the lateral or neighborhood roads connecting with them. Near the towns where the traffic is heavy, the roads will generally be improved, while those reaching back into the thinly-settled neighborhoods will probably be maintained as earth roads for years to come. It will, therefore, seldom be practical to give any one road in the county system the same class of maintenance for its entire length.

For the heavily traveled roads adjacent to the towns a patrol system is advisable, but on the less traveled roads the gang system will be found adequate and more economical. Such a force should be equipped with a light camp-outfit and be so organized as to cover all the roads which it is expected to maintain, at least twice a year. At the point where the patrolman stopped, the maintenance would be taken up by a gang organization, and extended as far back into the country as the road continues to be public highway. The gang system is especially adapted to the use of convict labor. If properly handled, convict labor should do the work at about half the cost as free labor. In addition to the maintenance work done by the gang, there should be some arrangement whereby persons living on the county roads would operate a road drag whenever the roads became rutted. As there is generally only one time after each rain when conditions are suitable for dragging, no one man should be given more road that he can drag properly in one day.

No system is self-operative, and a county maintenance system is no exception to the rule. Highway maintenance calls for greater ability and a higher degree of intelligence than highway construction, and therefore if the county system is to be successful it must have at its head a man who combines executive ability with some technical training. It does not matter whether he is called county engineer or county superintendent, he must be a man who can plan and lay out his work for a year ahead, estimate what it will cost, and then do it in a workmanlike manner within the amount of his estimate. Such a man will probably cost from two to three times as much as an untrained one, but he will save many times his salary and give you a dollar's worth of work for every dollar expended.

In connection with the maintenance of State roads, I referred to the division engineer having supervision over the patrolmen. Why should not each of the several counties join with the State and employ a competent man to supervise the maintenance of all roads in every county, each bearing its proportionate amount of his salary? With the State paying a part of the salary, the county could employ a higher class man than if it alone had to employ that man, while on the other hand, the State by joining with the county could secure more thorough supervision and materially reduce its overhead cost. Under this arrangement, the selection of the county engineer or superintendent would be made upon the joint approval of both the county and the State. He should be appointed strictly upon merit and be subject to removal at any time for inefficiency or neglect of duty. Complaint from either party to this agreement should be sufficient to cause his removal, but at the same time I would suggest that either should have the right to withdraw from the arrangement if they could not agree as to the fitness of the man in question. There should, however, be no difficulty in this respect, provided proper care was exercised in the original selection.

*State Road Commissioner of Florida.

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Concrete Highway Construction in Contra Costa County, California*

Contra Costa county is situated on the south-eastern shore of San Francisco and Suisun bays. The towns along the bay shore are mainly industrial, while most of the rest of the county is devoted to agriculture and grazing. The northern and eastern parts of the county are mainly level, while the southern and western parts are hilly, the highest point being Mount Diablo, of base line and meridian fame, with an elevation of 3849 ft. The population of the county in 1910 was 31,674 and of Martinez, the county-seat, 2115. The population in both cases has increased considerably since that time, largely because of the industrial development of the towns along the bay shore.

When completed, the State highway will run from the Alameda County line just south of Richmond, to Martinez, about 20 miles, There is a ferry from Martinez across Carquinez straits to Benicia on the other side of Suisun bay in Solano county. From Benicia the highway runs through Solano and the other counties of the Sacramento valley. This leaves the rest of the roads in Contra Costa county to be improved by the county itself.

FIG. 1. SURFACE OF FINISHED HIGHWAY SHOWING CORRUGATIONS.

Instead of issuing bonds, the county has decided to levy a special tax of $0.25 on $100 assessed valuation for the construction of permanent concrete highways. With the present assessment this will provide approximately $150,000 per year. The present plan provides for the construction of a highway from the county-line tunnel westerly to the county line near Byron and from Martinez southerly to the county line near Dublin, 66 miles in all. Of this amount, the so-called 'Tunnel' road from Oakland to Walnut Creek, 10¼ miles was completed last spring. It is estimated that the special tax will provide funds for the construction of 11 miles of highway per year, so that the highways proposed can be completed in five years. That the present tax is not burdensome is shown by the fact that there have been few if any complaints. There is, however, a strong movement to increase the special tax to $0.50 per $100 in order to complete the proposed system more rapidly.

The work at present under way is in two divisions, No. 3 and 4. Division No. 3 starts at a point near the south-east corner of the county and runs north-westerly and parallel to the Southern Pacific Railroad tracks to the town of Byron, and thence north, the total distance being 8.14 miles, of which about one mile that is now surfaced with good oil-macadam is not to be paved under the present contract. Division No. 4 extends from Antioch to Pittsburg, 3.49 miles. On division No. 3, the approximate quantities are as follows: line excavation, 20,700 cu. yd.; overhaul per 100 ft. in excess of 400 ft. free haul, 10,000 cu. yd.; bridge and culvert excavation, 760 cu. yd.; concrete in pavement, 10,477 cu. yd; concrete in bridges, culverts, and parapets, 467 cu. yd.; reinforcing steel in bridges, etc., 20,070 lb. On division No. 4 there is 29,500 cu. yd. line excavation, 35,000 cu. yd. overhaul, 400 cu. yd. bridge and culvert excavation,

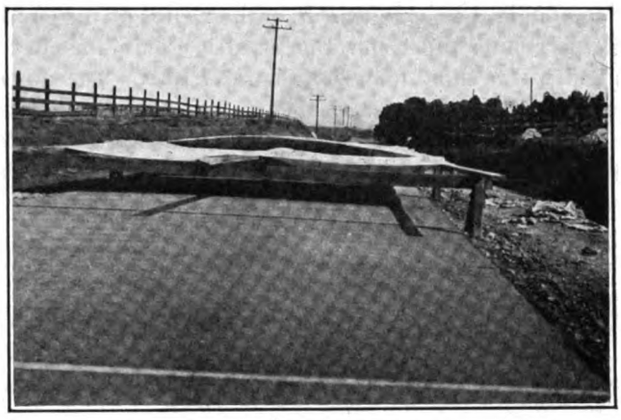

FIG. 2. FRESH CONCRETE PROTECTED BY CANVAS.

5000 cu. yd. concrete in pavement, 300 cu. yd. concrete and 20,000 lb. reinforcing steel in bridges and culverts, and 480 lin. ft. piling in bridge foundations.

Bids for the work were received on July 24 and the contract awarded to O'Brien Bros., of Martinez, at the following unit prices:

	Division No. 3 7.14 mile	Division No. 4 3.49 miles
Line excavation, per cu. yd.	$0.48	$0.38
Bridge and culvert excavation, per cu. yd.	1.00	1.00
Overhaul per 100 ft., per cu. yd.	0.01	0.01
Concrete in pavement, per cu. yd.	7.48	7.28
Concrete in bridges and culverts, per cu. yd.	11.00	11.00
Piling per lin. ft.	...	1.00
Steel, per lb.	0.07	0.07
Total	95,705.86	53,540.00

The specifications call for an 18-ft. concrete pavement 4 in. thick at the sides and 5½ in. at the centre. The

*Staff article.

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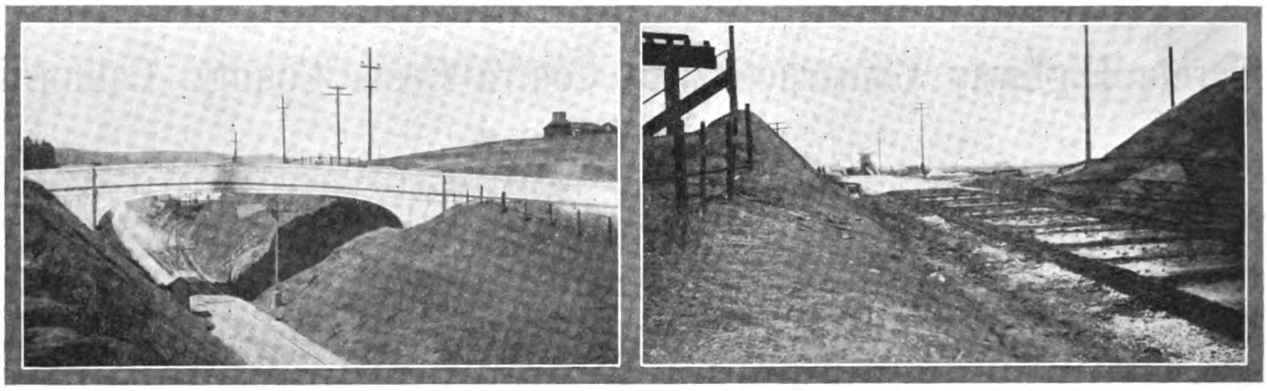

BRIDGE ON STATE HIGHWAY AT PEYTON AND NEWLY-LAID CONCRETE NEAR ANTIOCH.

header-boards of 2 by 6-in. Port Orford cedar are allowed to remain in place, and the earth shoulders are built against them. Expansion joints are placed 35 ft. apart and are made of 'Elastite,' a prepared felt $\frac{1}{4}$ in. thick and 6 in. wide. They are placed so as to project $\frac{1}{4}$ in. above the surface of the finished concrete.

On a few sharp curves the pavement has been widened to 24 ft. Super-elevation for the curves is calculated according to the formula

Elevation $= \frac{0.06688 \times w \times v^2}{R}$, in which $w = 18$ ft., $v = 30$ miles per hour, and $R =$ the radius of the curve. The maximum super-elevation used is 1.6 ft. for curves in which R is equal to or less than 677.16 ft. The super-elevation, wherever practicable, is begun not less than 50 ft. from each end of the curve, and at a greater distance where the grade is heavy. The inner edge of the pavement is kept either level or on the ruling grade. Vertical curves are figured according to the formula

Middle ordinate =

$$\frac{\text{Elevation at } B - \frac{\text{elevation at } A + \text{elevation at } C}{2}}{2}$$

where A and C, respectively, are the beginning and end of the curve and B is the point of intersection of the two grade-lines produced. Ordinates from intermediate points between A and B and C and B vary as the square of their distances from B.

Where the cut or fill is less than 1 ft., the sub-grade, for 10 ft. on each side of the centre line, is plowed for a depth of 6 in. and rolled in place. The embankments over 1 ft. in height are constructed in 1-ft. layers, each layer being diked and flooded before the next layer is placed. The sub-grade is rolled with a 15-ton roller. Pieces of the sub-grade that cannot be reached with the roller, including the part next to the header-boards, are hand-tamped. As a general rule, cuts are made 36 ft. and fills 30 ft. wide.

A 1:2:4 mixture is used for the concrete. Sand and coarse aggregate are supplied by the Grant Rock & Gravel Co. Mount Diablo cement is used. The specifications call for a one-minute mix. Specimen 6-in. cubes are cut from the pavement and tested after 28 days. These have shown an average compressive strength of 3200 lb. per square inch.

After the concrete is placed, it is brought to grade and 'struck off' with a wooden template. On division No. 3, the concrete has been finished by hand with wooden floats. On division No. 4, a heavy wooden template shod with iron and weighing in all about 350 lb. is used. A second template made of a 2 by 12-in. timber, shod with iron and to which there is attached plow-handles to allow of its use from a standing position, is used to finish the surface. All hand floating is done ahead of the smaller template. The surface is gone over several times or until the excess water is beaten out and a perfectly true and uniform surface is secured. This second template when properly used gives a slightly corrugated effect, as shown in Fig. 1, to the surface and makes it 'non-skid' without making it rough. It also has the advantage in that good results can be secured with unskilled labor. A canvas belt was used to finish part of the pavement. No asphaltic surface is to be used on either divisions No. 3 or No. 4, the county preferring to invest that amount of money in making a better grade of concrete. Except for a few hundred feet near the town of Antioch, no reinforcement has been used in the pavement. At this point the pavement was laid on a fill, the rigidity of which was doubtful, and a 3 by 8-in. mesh composed of No. 8 and No. 10 wire was used.

During the warm weather the fresh concrete was covered with canvas within an hour after being poured. Sometimes the canvas was supported as shown in Fig. 2, and sometimes it was simply laid on the concrete as soon as it was dry enough to prevent sticking. As soon as possible without damaging it, the concrete was covered with earth and diked and the earth kept wet for ten days. After the weather became cooler it was not necessary to use the canvas, simply protecting each day's work with wet earth as above. A Foote 'two-sack' mixer is being used on division No. 3 and a Smith 'three-sack' mixer on division No. 4. To guard against an excessive proportion of coarse aggregate a special type of wheelbarrow is used for measuring. It is difficult to load this wheelbarrow with more than 3 cu. ft. of rock.

Ralph R. Arnold is county surveyor of Contra Costa county and engineer in charge of the entire work. E. J. Daniels is resident engineer on division No. 3 and George E. McKay is resident engineer on division No. 4.

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Timber Framing—Part VII

By HENRY D. DEWELL*

Timber Trusses

In the last three articles of this series, the design of the details of timber trusses has been discussed and illustrated by typical joints of open-panel trusses. In this article, it is desired to show a complete truss, designed in accordance with the principles set forth in the preceding articles. Another type of roof-truss, the lattice-truss, as distinguished from the open-panel type, will also be described, and illustrated with a typical case. The design of the supporting columns is so closely interwoven with the subject of roof-trusses, as to require simultaneous treatment. In general, the illustrations of roof-trusses given in the text-books consider trusses supported on masonry walls. While this is a common case, the engineer or architect is confronted frequently with the problem of a timber-framed building, that is, a building with timber roof-trusses and timber columns, forming a structural frame supporting the walls and roof, which may be of wooden sheathing or of corrugated iron. Indeed, this latter case has been the most common in my experience. Here, many of the details which might be used in connection with masonry walls have had to be either discarded or modified. The timber columns do not merely support the dead weight of the roof-trusses; they become a part, with the trusses, of a definite structural frame, technically termed a 'transverse bent,' which resists the lateral forces of the wind and stiffens the building. This subject was briefly mentioned in the last article, in speaking of the function of bracing trusses. The designer of such a 'transverse bent' must consider carefully wind forces, and the means of providing for them. In this article it is not the intention to treat of wind forces in any detail, but the connections of trusses to columns will be discussed.

In Part IV, Plate VII shows a diagrammatic elevation and stress-diagram of a 70-ft. span Howe-type timber roof-truss. Fig. 52 of the present article gives the truss completely detailed. The spacing of the trusses is assumed at 24 ft., and the loading at 38 lb. per sq. ft. of horizontal projection of roof surface. For simplicity, all loads are assumed to act at the upper chord of the truss. This assumption is somewhat in error, as the dead weight of truss and bracing trusses should be taken as distributed between the upper and lower chords. The resultant error is, however, small and can be neglected in this case.

In the design, it has been further assumed that the roof-trusses are for a building of the 'mill-construction' type, that is, having a definite structural frame of timber trusses, columns, wall-girts, etc., and that some stiffness against lateral forces is desired, although no definite length of columns has been established, nor have any wind stresses been computed.

This detail presents what, in my opinion, is the most economical and efficient truss for such buildings. It is designed with conservative unit-stresses in all its details; it is simple of construction, and direct in its action. The rods are slightly larger than is required by the stresses indicated on the stress diagram in order to allow for initial tension when fabricating the truss. Washers of ample size are provided so that the rods can work to their full capacity. The butt-block type of intermediate joints has been used; hence the diagonal struts have full bearing at their ends. Attention is directed to the detail of the end-joint. This detail, where circumstances will permit of its use, is believed to be the most efficient and at the same time, the cheapest, that can be found. (If the lower chord could extend beyond the post, the end details, Types *A* and *B* of Part IV could be used). The roof-joists rest directly upon the upper chord. While this introduces the secondary stresses of bending into the chord, the joists at the same time support the chord laterally in its weakest dimension, acting as a column, and so permit rather high unit fibre-stresses. To give sufficient lateral support, it is required that the roof-joists be well spiked to the chord, and that they also be well spiked at their laps. In the end-panels, bolsters have been provided for the lower chord. These bolsters, being well bolted to the chord, not only take care of any secondary stresses due to the action of the end-detail, but also provide additional bolting space for the attachment of the lower chord to the column.

The truss rests concentrically on the posts, hence there is no bending in the post due to eccentric loads. To accomplish this result, it is necessary that the knee-braces be cut and framed into post and bolster after the truss has been erected and all of the dead load of the roof is in place. Otherwise, the slight deflection of the truss, when the roof load is placed, will cause the knee-braces to transfer a horizontal thrust to the post, with consequent bending in the post. Possibly this may seem an unnecessary refinement in timber-framing; however, the cost of cutting and fitting the knee-braces after the truss is erected and the roof loads are in place is not excessive, and I believe that the slight additional expense is justified.

Note the bolting of knee-braces to post and truss chord with cast-iron bevelled washers. The use of such

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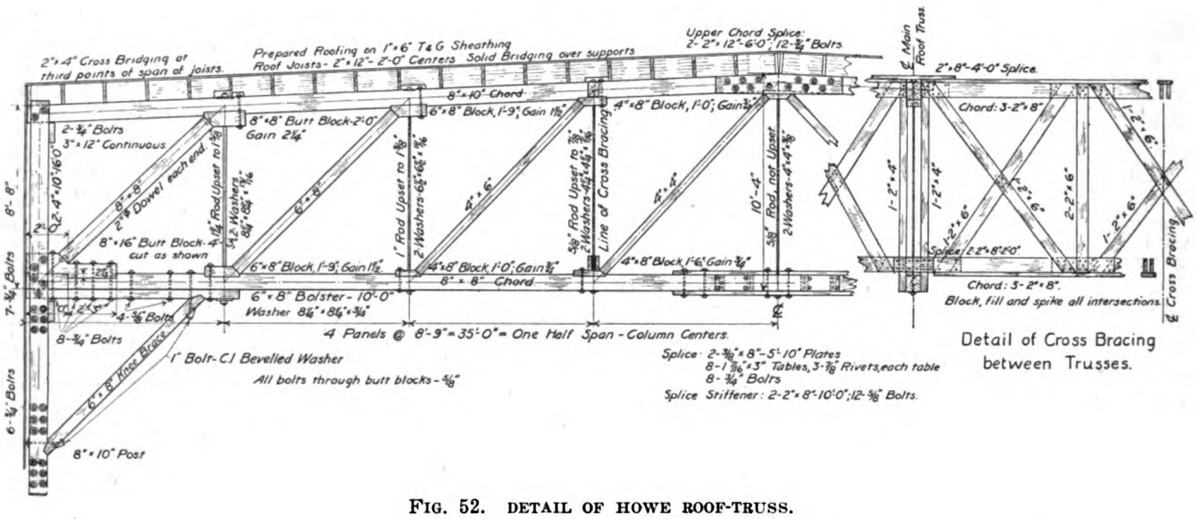

FIG. 52. DETAIL OF HOWE ROOF-TRUSS.

washers, set into the knee-brace, insures that the brace is capable of withstanding some tension. If computations for wind show that the knee-braces must take considerable tension, metal side-plates, bolted or lagged to the knee-brace and to the post or truss-chord and bolster may be substituted for the bolts shown. Without going into the theory of wind stresses in transverse framed-bents at this time, it may be said that the exact distribution of the wind moment in the column in this case is somewhat indeterminate, not only from the fact that the condition of the base of the post is unknown, that is, whether 'hinged' or 'fixed,' but also from the conditions here present of three intersections of the truss with the post, namely, the connection of the knee-brace to the post, and the connections of the upper and lower chords to the post. However, the statement may be made that the maximum bending-moment in the column occurs either at the foot of the knee-brace or at the intersection of the lower chord with the post. For this reason, the detail here shown, with the post spliced over the truss, the splice-pads with a total capacity in bending equal to that of the post, and extending well below the foot of the knee-brace, and bolted thoroughly to the post and truss, provides a condition of maximum stiffness consistent with simplicity of fabrication and ease of erection. If the knee-brace is omitted, as is common in many instances, the computation of the bending moment due to wind, and the forces acting on the bolted joints, is a simple matter. For the purpose of presenting the conditions of wind bending in such a case, diagrammatic representations of these moments have been prepared and are shown in Fig. 53, *a*, *b*, and *c*, which illustrate the influence of the end conditions of the columns. Fig. 53 *a*, represents the bending for a column with 'free' or 'hinged' ends; Fig. 53 *b* shows the bending for a column with 'fixed' ends; while Fig. 53 *c* illustrates the bending for an intermediate condition, namely, for a post half-way between hinged or fixed at the base.

Fig. 52 also shows the detail of the bracing-trusses between the main roof-trusses. Such a truss, as was explained in the preceding article, may play an important part in resisting the wind on the building; its chords may, in such a case, take stresses, either of compression or tension, that can be calculated with a reasonable amount of accuracy. Its connection with the main truss must then be carefully studied, particularly the splices, in order that it may fulfil its part properly in the general scheme of bracing the building. On the other hand, the bracing trusses may take no stresses that can be computed. Nevertheless, no roof-truss should be constructed without due attention to the need of bracing trusses. The detail shown here is simple and cheap, and at the same time is effective.

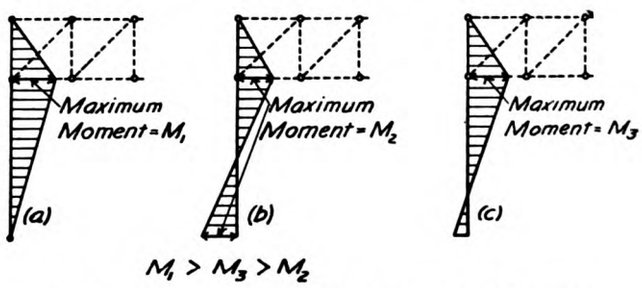

FIG. 53. BENDING-MOMENT DIAGRAM FOR WIND-STRESSES.

Note the 'T' section of the chords, enabling them to take compression, as well as to tie the main trusses together.

The splice of the lower chord merits mention possibly. Beside the steel-tabled fish-plate splice, which has a capacity of the computed stress in the chord in this panel, two wooden stiffening splice-pads are bolted through the chord to give the truss additional stiffness during erection. Some criticism may perhaps be made of placing a tension-splice at the point of greatest chord-stress. While such a position for the splice is not desirable and should in general be avoided, the lengths of available timbers will sometimes require placing the splice at the centre of the truss. If due attention is given to the detail, and conservative unit-stresses are used, there need be no apprehension of the strength of the truss.

It should be noted that Fig. 52 does not represent a

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working detail, and is not intended as such. To make *this* detail a 'working' drawing, for shop and field, sundry additional information should be given, such as a *shop* drawing of the steel splices, spacing of all bolts, etc.

Lattice-Trusses

The lattice-truss, diagrammatically illustrated in Fig. 54, is often employed in roof construction for moderate spans. This type of truss, as distinguished from the open-panel type, was probably first used for bridges. Burr and Falk, in their 'Design and Construction of Metallic Bridges,' Edition 1905, note "A later type of timber bridge which was most extensively used in this country was invented by Ithiel Towne in January, 1820, which was known as the Towne lattice-bridge. This timber bridge was among those used for railroad structures. It was composed of a close timber-lattice, heavy planking being used for the lattice members, and they were all joined by wooden pins at their intersections. This type of timber structure was comparatively common not longer than twenty-five years ago, and probably some structures of its kind are still in use. The close lattice work with its many pinned

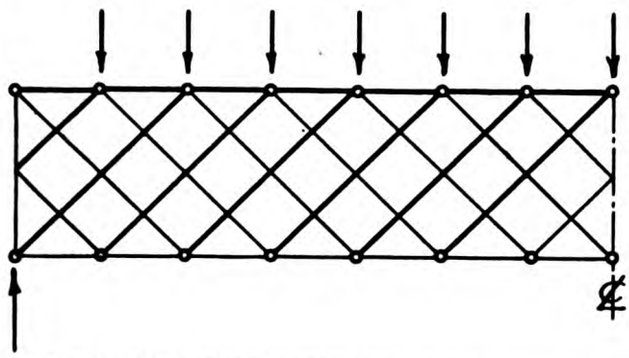

FIG. 54. OUTLINE OF HALF-ELEVATION OF LATTICE-TRUSS.

intersections made a safe and strong framework, and it enjoyed deserved popularity. It was the forerunner in timber of the modern all-riveted iron and steel lattice-truss. It is worthy of statement, in connection with the Towne lattice, that its inventor claimed that his trusses could be made of wrought or cast-iron as well as timber. In many cases timber arches were combined with them."

Fig. 62 illustrates a typical latticed railroad-bridge, on the Boston and Maine Railroad, built in 1902, the illustration being taken from Merriman and Jacoby's 'Roofs and Bridges,' Part I. An inspection of this illustration shows that the chords of these trusses are firmly supported laterally, the top chords by the upper lateral-bracing, and the lower chords by the floor system, and undoubtedly also by the usual lower lateral-bracing. In using the lattice-truss as a roof-truss, especial care must be taken to see that the unit compressive-stress in the upper chord does not exceed the safe unit-stress for the chord treated as a long column. Due to the necessity of making the chords of a lattice-truss deep for bolting, and the use of thin material for the web members, the truss as a whole is rather thin and deep, as compared with a truss of the Howe type, for example. It will therefore have a tendency to twist, and must be braced accordingly.

When the roof-surface slopes from the centre of the truss to the ends, the upper chords may be given the slope of the roof, or the truss may be constructed with horizontal chords, and the roof-surface furred, either by means of a low studded-wall or short post and roof girder. The truss with a sloping upper-chord is somewhat more difficult to construct, as the diagonals have different lengths, and the intersections of diagonals and upper chord are not uniform. For this reason, I prefer in general to build such trusses with parallel chords, and then to construct a studded-wall on the upper chord. In such an event, the trusses must be tied together by bracing trusses or struts, with possibly the additional precaution of stiffening the upper chord laterally by means of a 2-in. plank nailed to the upper edges, forming a 'T' section.

It is hardly necessary to say that the lattice-truss is an indeterminate structure, and that the exact stresses cannot be found by the ordinary methods for solving the stresses in a roof-truss. It is customary to consider the truss as a combination of a number of Warren trusses, each taking its proportion of the total load. The chord-stresses are, of course, the sum of the chord stresses in the individual Warren trusses. Or, the lattice-truss may be computed as a plate girder in determining the approximate chord-stresses. For finding the stresses in the diagonal web-members, the shear at any section may be divided by the number of web-systems, and the quotient resolved into the line of the diagonal. For finding the required number of bolts or nails fastening the webs to the chords, the stress in the diagonal must be resolved into the two components parallel to and perpendicular to the chords, respectively. The component perpendicular to the chords, or the shear in the section, acts through the bolts across the grain or fibre of the chord-timbers, and hence may be the feature determining the size of the bolts.†

To illustrate the design of a typical latticed roof-truss, there is here given the computations for a truss of this type, shown in Fig. 55. The span is 40 ft., the spacing 24 ft., and the total loading, including the weight of the truss, 35 lb. per sq. ft. of projected horizontal roof-surface. The figure gives a half elevation of the truss. For finding the maximum stresses in the diagonal web-members, the stress diagram shown in Fig. 56*b* has been constructed.

All intersections of web-members are spiked, and the intersections of webs and chords are spiked in addition to the bolting. Fig. 55 shows the attachment of the lateral bracing which consists of a bracing truss at the centre of the span, and a strut between trusses at

†This is strictly true of the end-diagonals only; the size of the bolts in the intermediate diagonals are determined from consideration of pin action, as explained in the detail computations.

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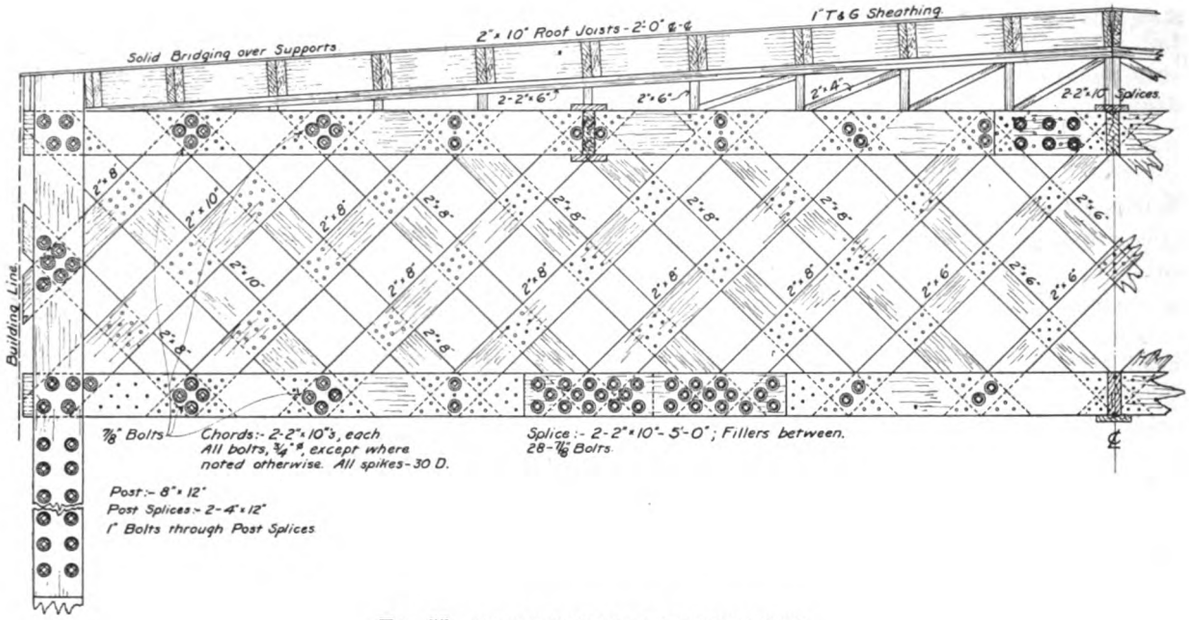

FIG. 55. HALF-ELEVATION OF LATTICE-TRUSS.

the quarter-points of the span. For a truss of this span and loading, it is not necessary to use fillers between webs and chords, but for trusses of greater span or loading such fillers may be required.

The lattice-truss is not an efficient truss from the standpoint of material, but where timber is comparatively cheap, and steel in the form of rods, plates, etc., is either expensive or difficult to procure, this type of truss may be the most economical to use. The lumber required is all dimension stock, and may be had in any lumber-yard, and the bolts are stock bolts. The skill required in framing is small, and the ordinary house-carpenter may do a satisfactory job. The weak feature of the latticed roof-truss is usually found to be the tension-splice of the lower chord. This splice should be carefully designed, and an ample number of bolts be provided to take the chord stress at that point. For determining the chord stress at any point, a simple method is to construct a bending-moment diagram similar to that shown for this truss, in Fig. 56*a*.

Computations for Lattice-Truss. Span, 40 ft. Spacing of trusses, 22 ft. Depth of trusses: The depth of a truss with horizontal chords, namely, the vertical distance between the centre lines of the chords, should be between $\frac{1}{6}$ to $\frac{1}{10}$ of the span, $\frac{1}{8}$ being an economical ratio. In a lattice-truss with both chords horizontal, the depth should be a simple proportion of the span, in order to secure good intersections of diagonals with the chords. The depth in this case will be taken at 5 ft., which is a ratio of depth to span of $\frac{1}{8}$.

Loading of horizontal projection of roof, 35 lb. per sq. ft.
Total load on truss = 22 by 35 by 40 ft. = 30,800 lb.
Gross reaction = $\frac{1}{2}$ total load = 15,400 lb.
Maximum bending moment = $\frac{1}{8} \times 30{,}800 \times 40 = 154{,}000$ lb.-ft.

$$\text{Maximum chord stress} = \frac{154{,}000}{5} = 30{,}800 \text{ lb.}$$

$$\text{Required net area of tension chord} = \frac{30800}{1500} = 20.4 \text{ sq. in.}$$

The chords will be composed of two 2 by 10-in. timbers, giving a gross area of 40 sq. in., or twice the net area required. This may appear excessive, but 2 in. is the minimum thickness that should be used, and the width of 10 in. will give ample bolting and spiking

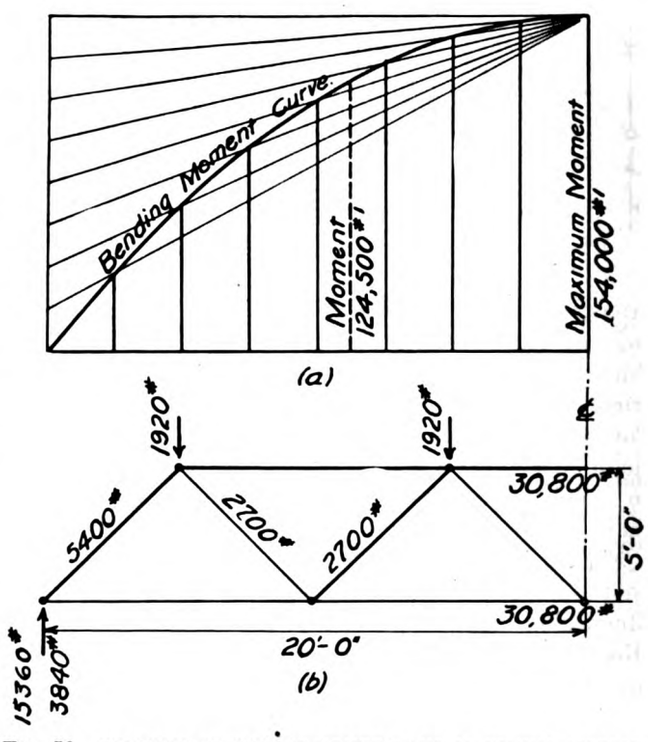

FIG. 56. DIAGRAM OF BENDING-MOMENT AND MAXIMUM STRESSES IN CHORDS OF LATTICE-TRUSS.

space, which is a vital requirement. The strength of the truss depends upon the bolting and spiking, and for bolting to be effective, the bolts must not be placed too close together, nor too close to the ends or the edges of the timbers.

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Stresses in Diagonal Members. (See Fig. 56*b*.) This *figure* represents one of the four web-systems, each forming a Warren truss. The panel loading for one such system is $2\frac{1}{2} \times 22 \times 35$ lb. $= 1925$ lb. The maximum diagonal stress is 5400 lb. The same result is reached by working from the end reaction. Thus, dividing the total reaction by the number of web-systems, and resolving such shear into the line of the diagonal, there results,

$$\frac{15400}{4} \times 1.407 = 5400 \text{ lb.}$$

Bolting and Spiking of Diagonals. If spiking alone were to be counted upon for fastening the web-members to the chords, each web-member would have to have sufficient spikes fastening it to the chord to transmit the stress in such diagonal. A 30D spike is $4\frac{1}{2}$ in. long; this size of spike is about the largest that should be used. The safe resistance of a 30D spike to lateral shear is 240 lb.; eleven spikes is about the maximum number that may be used without danger of splitting the timber. The maximum resistance of spiking is therefore 11×240 lb. $= 2640$ lb. In order that both chords may act together, they should be bolted through, in addition to the spiking. For the web-members with a stress of 2700 lb. (see Fig. 56*b*), two $\frac{3}{4}$-in. bolts and nine 30D spikes will be used. This will take care of all panel-points except the first four from the ends.

For the first four panels from the end, the bolts will act as pins, with forces as shown in Fig. 57, *a*, *b*, and *c*. In Fig. 57*a* and *b*, the web-stresses are resolved into their components in horizontal and vertical planes, the reactions found, and the moments computed. Fig. 57*c* shows the resultant moment to be 5400 in.-lb. Four $\frac{7}{8}$-in. bolts will give a resisting moment of 4200 in.-lb. at a flexural stress of 16,000 lb. per sq. in. Using four $\frac{7}{8}$-in. bolts, then, there is required in addition $\frac{5400 - 4200}{5400} \times 5400 = 1200$ lb. to be taken by spikes directly into the chords from one diagonal. The detail shows six 30D spikes, which are good for 1440 pounds.

Where the end diagonals intersect the chords and posts, it is essential to secure a strong connection. To accomplish this purpose, two of the end diagonals have been made 2 by 10 in., and 1-in. bolts are used through the post splice-pads. The actual bending on these bolts is difficult, if not impossible to determine, depending somewhat upon the efficiency of the filler between the web-member and the chord. The bolting shown will be ample, however, to take care of the stresses indicated by Fig. 56*b*. Theoretically, the centre web-members take no stress for uniform loading. For this reason, they have been reduced in size to 2 by 6 inches.

Lower-Chord Splice. For determining the chord stress at the point of splice in the lower chord, the bending-moment diagram of Fig. 56*a* has been constructed. On a base of one-half the span of the truss, a rectangle is drawn with a height proportional to the maximum bending-moment at the centre. The base and the left side of the rectangle are then divided into the same number of equal parts, in this case, eight. From the upper right-hand corner of the rectangle, radiating lines are drawn to the division lines of the left side. The intersections of these radiating lines with the verticals erected on the base line at the points of division determine the parabola representing the bending-moment. From this bending-moment curve, the moment at the point of the splice is seen to be 124,500 lb.-ft., and the chord stress is therefore $\frac{124500}{5} = 25{,}000$ lb. The detail shows fourteen $\frac{7}{8}$-in. bolts, which from the values given in Part III, have a resistance of 26,600 pounds.

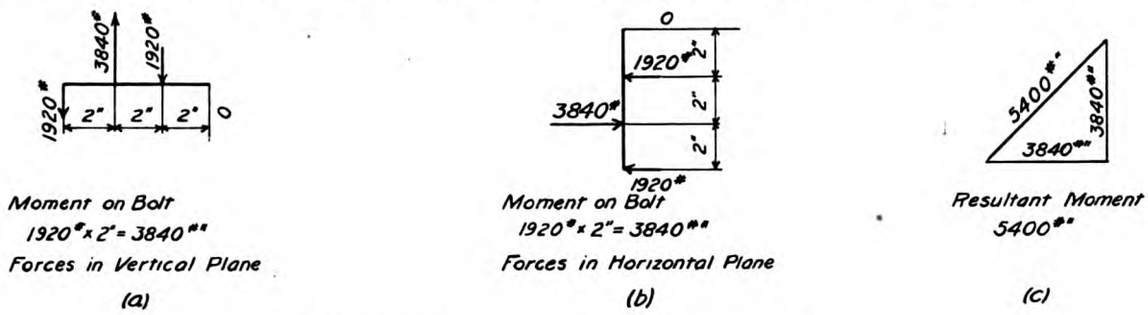

FIG. 57. MOMENT-DIAGRAMS FOR DIAGONALS OF LATTICE-TRUSS.

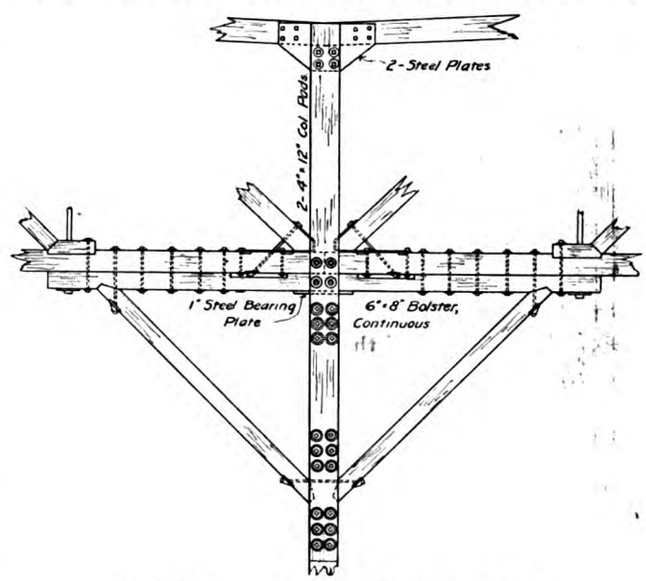

FIG. 58. CONNECTION OF TRUSS AND POST.

Upper-Chord Splice. As the upper chord is in com-

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pression, a true butt-joint will be assumed, and the splice-pads designed merely for holding the joint together, and supplying some tensile resistance for unknown erection stresses. The post has been assumed as an 8 by 12-in. timber. As detailed, the truss rests directly upon the post, and for stiffness against lateral forces, two 4 by 12-in. splice-pads are provided, well-bolted to the post and to the truss.

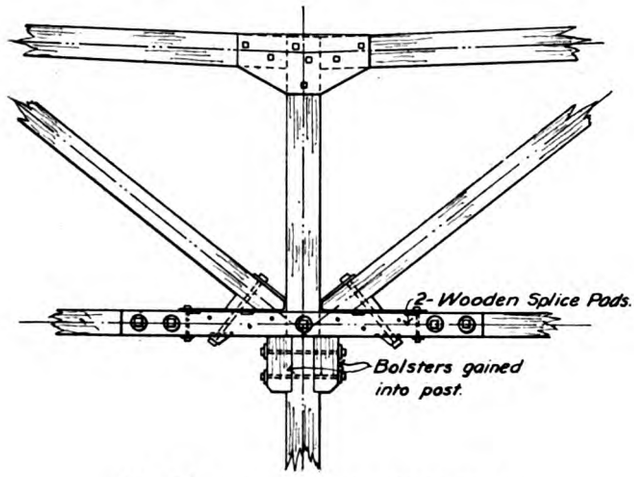

FIG. 59. TRUSS AND POST CONNECTION.

The preceding discussion illustrates the method of design of a lattice-truss. While, as was noted previously, the stresses are indeterminate, the approximate stresses can be found, and a reasonably rational design made. In some instances, particularly where there is a ceiling-load to support, it may be advisable, and

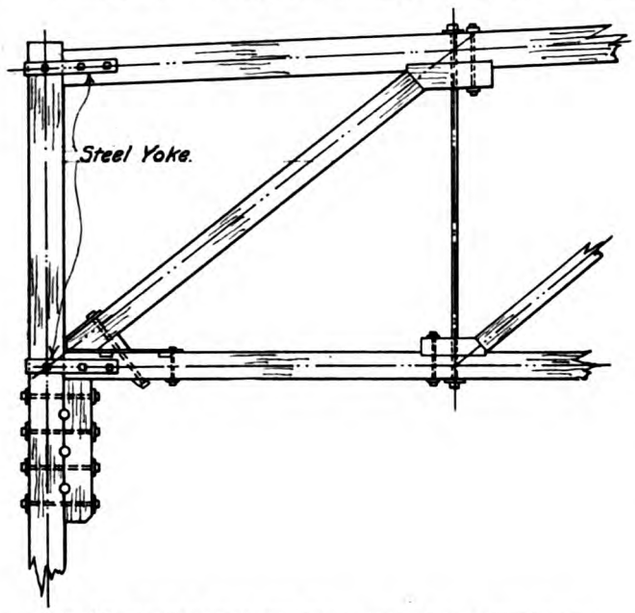

FIG. 60. POORLY DESIGNED TRUSS AND POST CONNECTION.

even necessary, to make the chords of four pieces, instead of two. Kidder's handbook gives the sizes for lattice-trusses of various spans and spacing, and recommends in all cases chords constructed of four timbers. This practice, in my opinion, is not advisable, since the wider the chords, the more space there is available for bolting and spiking. It might be mentioned that the use of four planks to each chord results in what are termed 'cumulative stresses.' In other words, the two chord-timbers next to the web-members must not only take their own proportion of the total chord-stress, but must also transmit the part of the total stress borne by the two outside chord-timbers. This construction, therefore, results in an overstraining of the two inner chord-timbers.‡

The method of connection of truss to post, illustrated in Fig. 52 and 55, furnishes what in my opinion, is the most efficient detail that can be devised. If there are

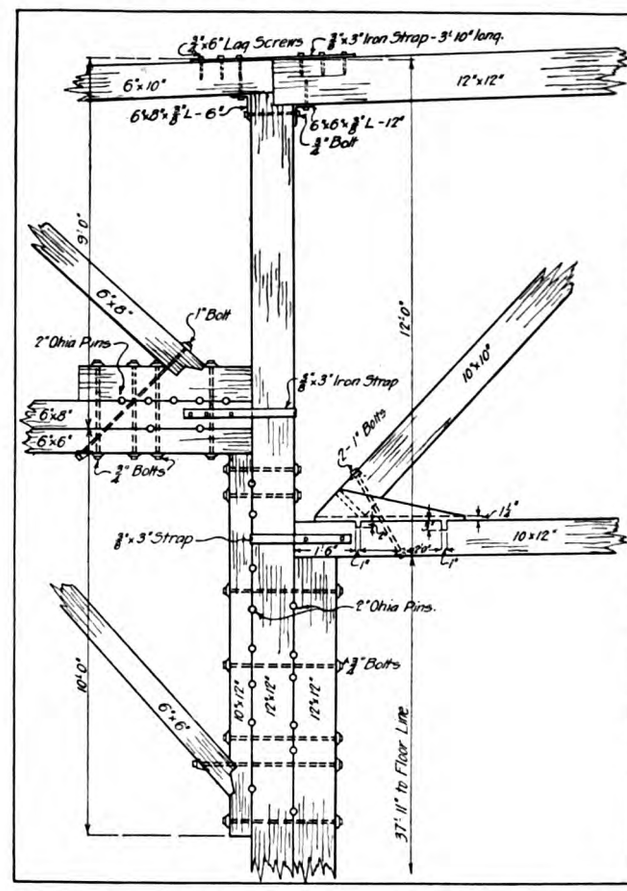

FIG. 61. TRUSS AND POST CONNECTION THAT IS WEAK AND YET WASTEFUL OF MATERIAL.

interior posts, that is, if there are several trusses across the width of the building, this detail can only be used for the outside, or wall posts, and the connection to the interior post or posts, will have to be modified. Fig. 58 and 59 illustrate two methods that may be used,

‡In this connection, note the following statement from Kidder's 'Architects and Builders Pocket Book,' edition 1905, page 898, "The bottom chord should also be bolted every two feet between the joints, as this member is in tension. The top chord, being in compression, will be tied sufficiently by the bolts at the joints, and by a short bolt on each side of the butt joint." This statement is misleading; in a lattice-truss with each chord built of four sticks, the upper chord needs through bolting to the same extent as the bottom chord. For splicing the tension member, special bolting and spiking is required. In general, the bolts between the joints will have to be spaced closer than 2 ft. centre to centre.

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Fig. 58 being for the Howe truss of Fig. 52. For this case, the end-detail of Fig. 52 must be abandoned, on account of lack of room, and a steel shoe substituted. As between the two details of connections to post shown in Fig. 58 and 59, the particular circumstances of the building to be framed must determine the type of connection. The wind shear to be transferred across the post may require special treatment with a special detail. The post in the detail of Fig. 59 is considerably weakened by 'gaining' the bolsters into the post, and this reduced section is at the critical point for resistance to wind-stresses.

Fig. 60 shows a detail of connection of truss to a wall post which is not good, but which I have seen used to a considerable extent. In this detail, there is eccentricity of loading, and a consequent bending in the post, notwithstanding the fact that the centre lines of the post, lower-chord and batter-post intersect in a common point. Were the end of the chord to bear snugly against the post, and were the iron tie-strap to provide sufficient tensile connection between truss and post, the joint would not produce bending in the post. In actual construction, however, the truss will invariably be cut slightly short to facilitate erection. Even with an initial snug fit, shrinkage of the post will soon destroy this tight fit. Similarly, the post will shrink away from the yoke, and the value of the tie-strap be largely lost. The detail thus gives a false impression of stiffness. It is true that the joint may be tightened after shrinkage has taken place by shimming and wedging, but the chance of this extra work being done after the building is completed is small, and any connection which minimizes the effect of shrinkage is to be preferred.

It is sometimes instructive to learn how not to do things. Fig. 61 is a detail of a truss and post connection used in one of the concession buildings at the Panama-Pacific International Exposition. It is reproduced here to illustrate how it is possible to use a great quantity of material without obtaining great strength, and especially without gaining an appreciable amount of stiffness. Expensive construction does not necessarily mean strength. The principal defect of the construction shown is its lack of stiffness. The only ties between truss-chords and posts are the small steel tie-straps or yokes, fastened with lag-screws. As these yokes bear across the fibre of the posts, their maximum resistance limited by this stress is $36 \times 300 = 10{,}800$ lb. As a matter of fact, the pressure across the face of the post would never be uniform, as the strap is not stiff enough to so transmit the pull. The pressure would all be concentrated near the sides of the post, and would crush the corners of the post, should any amount of pull come upon the strap. As shown above, shrinkage of the timber would soon destroy the efficiency of these yokes.

Both end-details are objectionable. The double cut on the end connection of the left truss, with a small shearing area is inefficient. Double cuts similar to this introduce cumulative stresses, as the total horizontal component of the thrust of the batter-post must eventually come upon the shearing area between the inner or lower end-cut of the batter-post and the end of the bolster. The cast-iron shoe of the truss on the right is poorly designed. Here again the two different depths of lugs introduces cumulative stresses in shear. The thickness of 1 in. for the first lug with a depth of 2 in. is altogether too small. If the full stress ever came upon this lug, it would fail through flexure. For a unit-bearing pressure of 1600 lb. per sq. in. this lug would be stressed in flexure to 31,200 lb. per sq. in., acting as a cantilever. No bolts are provided to hold the inner lug in its cut in the timber.

While, because of the large live load figured on the truss, and the safety factor, the truss was in no danger of falling down, such designs are not only uneconomical, but the owner of such a building is not getting

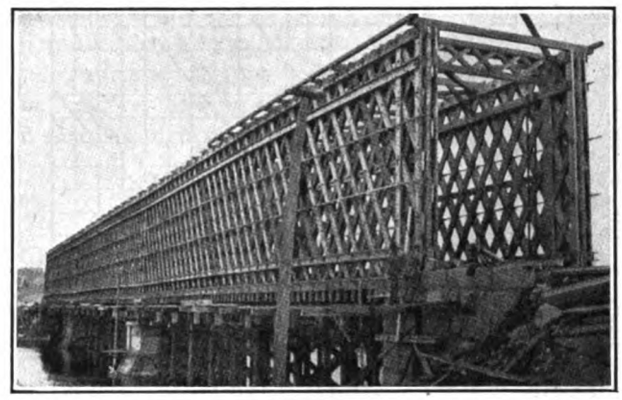

FIG. 62. SIMPLE LATTICE-TRUSS BRIDGE ON BOSTON AND MAINE RAILROAD.

security in proportion to money expended. A stronger and stiffer structure could have been secured at a less expense. When a competent engineer checks such a design, and points out, for example, the weakness of the tie-straps or the end-details, he is sometimes accused of attempting to add material unnecessarily, and to prove the claim, the sizes of the different members are pointed out, as sufficient evidence of the safety of the structure. Sometimes, one of the most difficult things to make an owner realize, is that heavy members of trusses and posts do not necessarily indicate a strong construction.

The development of foam along the margins of rising streams is a result of the escape of air and gas from the soil after it has been covered with water. Observation along the edge of a stream during a rise will show quantities of air bubbling to the surface and forming foam. Foaming is especially notable where the water rises over ground covered by vegetation, but it occurs also on bare, loose sand and gravel bars.

Costs of public-land surveys in Utah for the fiscal year ended June 30, 1916 are summarized in a recent report by I. C. Thoresen, surveyor general for that State. During the year, 1868.5 miles of line was run at a total cost of $35,122.19, or an average of $18.82 per mile.

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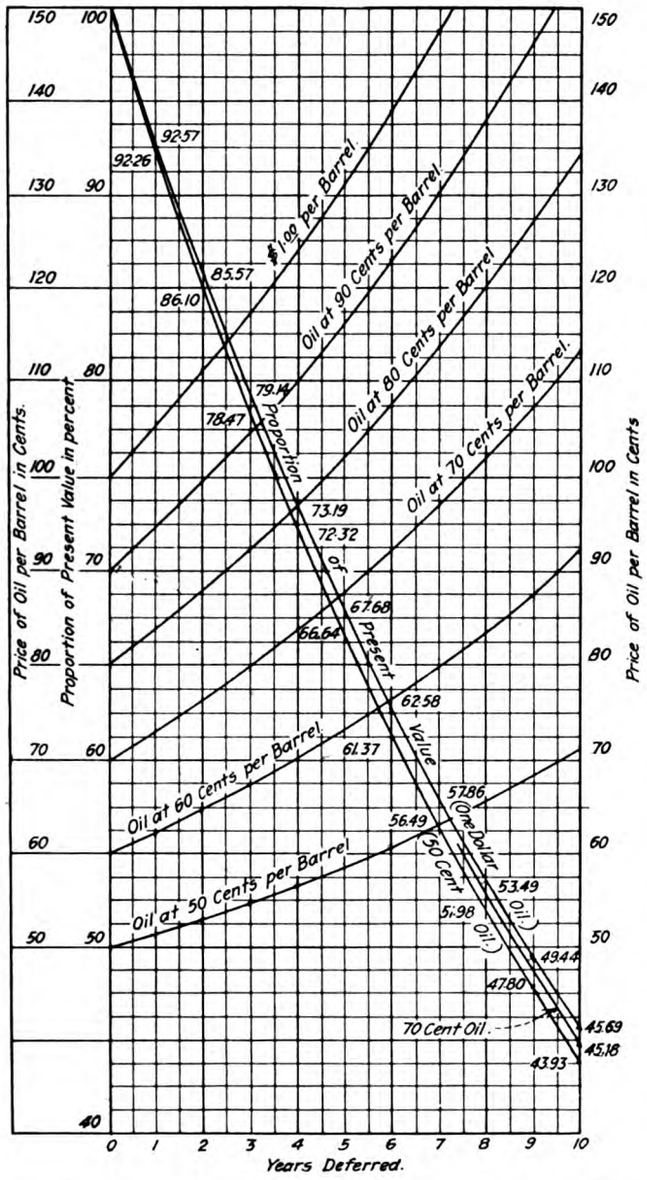
DIAGRAM FOR COMPUTING RESULT OF SUSPENDING OPERATIONS ON AN OIL-PROPERTY

By THOMAS COX*

The accompanying diagram, computed for properties in the Coalinga field, shows the decline in present value resulting from suspending operations on an oil-property, also the price of oil at the end of the period necessary



in order to compensate for deferred production. Thus with oil at $0.70 per barrel and the property 'shut-down' for eight years, the required compensating price at the end of the period would be $1.02 per barrel.

Air-drill hose is often affected unfavorably by workmen pouring oil in the hose itself before connecting to the drill-machines. This saves them the labor of unscrewing the oil-plugs of the drill and replacing them. The oil may be good for the drill but surely is bad for the hose.

*Consulting engineer, 463 Ellita avenue, Oakland.

EXPLOSIVES

Nitro-glycerine is a limpid oil formed by the action of a mixture of nitric and sulphuric acid upon ordinary glycerine. This chemical action is a violent one unless carefully controlled. After it has taken place, the nitro-glycerine is washed repeatedly to remove any trace of acid that might remain. The presence of acid is dangerous in the finished explosive because it may produce a chemical action of disastrous results. For practical use, the liquid nitro-glycerine is so sensitive to percussion and friction that it is dangerous to transport it or attempt to employ it alone. However, when nitro-glycerine was first introduced for driving the Hoosac tunnel in Massachusetts, and for springing oil-wells in Pennsylvania, it was used alone, being carried in copper cans and loaded in tin tubes. In the oil-well region, men made an occupation of driving a horse and light wagon through the country for carrying the pure nitro-glycerine to the consumers. Many accidents were reported, and a carrier's position was scarcely to be envied.

Later it was learned to mix the nitro-glycerine with a quantity of kieselguhr, an infusorial earth composed of the silicious skeletons of minute diatoms, and therefore called diatomaceous earth. The nitro-gylcerine is absorbed by the earth, which is itself inert and simply forms a plastic mass that can be more safely handled than the nitro-glycerine. Another advance came when it was found that nitro-cellulose, or gun-cotton, could be dissolved in the nitro-glycerine to form a nearly uniform jelly. This mixture constitutes blasting gelatine. The gun-cotton is made by the action upon cotton fibres of the same acids as are used in the manufacture of nitro-glycerine, great care being taken to wash away all trace of excess acid. When gun-cotton, or nitro-cellulose, is incorporated with the nitro-glycerine, it shares in the explosion, instead of acting as an inert base like kieselguhr. Thus additional power is gained. Blasting gelatine, then, is a mixture of two complex compounds, which fact increases the possibility of chemical change with consequent deterioration and danger. Blasting gelatine contains 92% nitro-glycerine and 8% nitro-cellulose. There are, also, various intermediate mixtures of nitro-glycerine and nitro-cellulose with a proportion of wood meal and potassium nitrate, the object being to product effects intermediate between straight dynamite and blasting gelatine. When such a complex mixture was attempted, it was at first difficult for any mechanical method to render a perfectly homogeneous mass, but later methods of manufacture have improved this.

The initial pressure of the different explosives when detonated in their own volume are as follows: straight dynamite (nitro-glycerine mixed with an inert base) 80 tons per square inch, blasting gelatine 113 tons, gun-cotton 71 tons, black powder 21 tons. It is evident that blasting gelatine is the most powerful. Likewise it has the highest rate of detonation, 25,262 ft. per second, as against 22,368 for straight dynamite and 984 for black powder.

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Sinking Through Sand*

By EDWARD A. SAYRE

A common method of sinking through difficult ground employs a steel shoe pushed ahead of the shaft-timbers; another is the drop-shaft method. These two methods were used at the Eagle No. 3 mine, Des Moines, Iowa, and the following data show the relative cost of the two methods under the same conditions. The material to be penetrated was 73 ft. of drift and sand, including several clay streaks.

STEEL-SHOE METHOD. The method of sinking the main shaft by the steel-shoe method was to agitate the sand and force the shoe through it by means of jack-screws. Two methods were used to agitate the sand. First, while the men could reach the bottom of the shoe, they stirred the sand with spades. Later the pumping system was used. The discharge of the No. 6 Cameron pump could, when desired, be sent through five $\frac{3}{4}$-in. pipes, and the five jets of water could be played upon the sand at the bottom of the shoe. It was found that these jets would agitate the sand sufficiently to permit the jack-screws to push the shoe down, except when the sand was at too high a level inside the shoe, in which case sand would have to be excavated before the jet process could be resumed. In using this process the men would stir the sand with the jets for about 10 min., and then tighten the jack-screws. When sufficient space was obtained between the timbers in the shoe and the curbing above, the two jack-screws of one side were removed, and timber put in place on top of the timbers in the shoe, and then the other jack-screws were moved. An advance of 18 in. per day was exceptional, more often it was less than a foot.

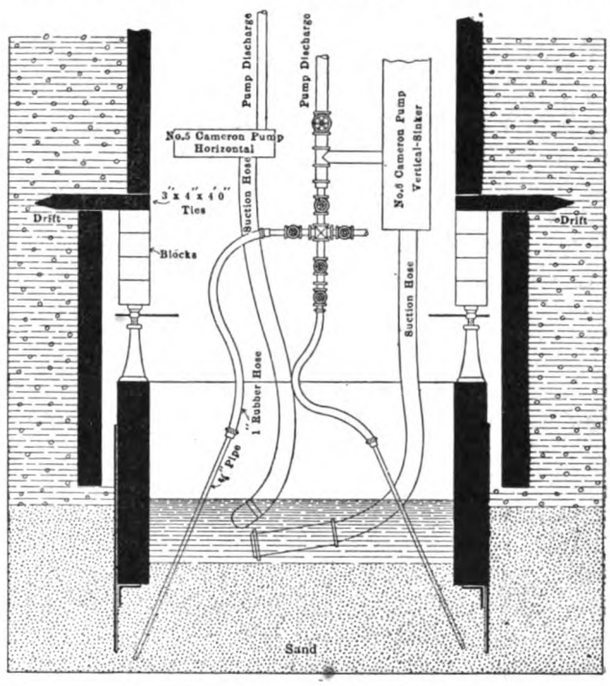
Necessarily some sand had to be excavated. This tended to cave the dirt around the shaft, which in turn caused an excessive down pressure and broke the curbing. An attempt was made to overcome this by supporting the curb with I-beams and cables from the surface. Ten 12-in. beams were supported on cribs at the surface, and ten 8-in. beams were swung under the angle below the ties, being connected by twenty $\frac{7}{8}$-in. steel cables. When the sinking was resumed, the curbing continued to break, the I-beams bent, and two cables were broken. Since it appeared impossible to hold the curb, it was decided to timber the shaft solid from the 8-ft. level (where the most uniform break occurred) to the bottom of the shoe, and then drop this portion of the shaft through the remaining 5 ft. of sand.

To do this, the ties were driven back into the wall and solid timbering put in between the shoe and the upper curbing of the shaft. The entire shaft curbing from the 8-ft. level down was then tied together with 2 by 6-in. stringers. At the 8-ft. level planks were spiked to the lower curb, the upper ends projecting above the break preventing the loose material from falling. The jet system, using occasional excavation of sand, was resumed, and the shoe, with 50 ft. of curbing, was lowered.

In landing the shaft on solid rock, seven boulders 1 to 2 ft. in diameter were encountered. Six of these were under the cutting-edge of the shoe, and were removed only after being broken by chisel and sledge.

While lowering the shaft through the last 5 ft., the upper timbers buckled 18 in. out of line. This necessitated re-timbering from the sand to the surface, an expensive undertaking because the old timbers had to be cut out and replaced in sections.

On completion of the re-timbering, sinking through the shale was commenced. Three shifts were used making a daily advance of 5 ft. The only problem in the shale was the elimination of the water, most of which stopped when the solid rock was reached. This water was taken care of by placing a water-ring at the 85-ft. level with a pump to elevate the water to the surface.



STEEL-SHOE METHOD USING JACK-SCREWS.

DROP-SHAFT METHOD. The air-shaft was located 350 ft. from the main shaft, and conditions were similar except that the surface at this point was 10 ft. lower, making the distance to be traversed to rock 63½ ft. The equipment was the same used at the main shaft. The air-shaft followed a drill-hole tapped by an entry from the main shaft, so that most of the water was drained

*Abstract of paper prepared for the Arizona meeting of the American Institute of Mining Engineers.

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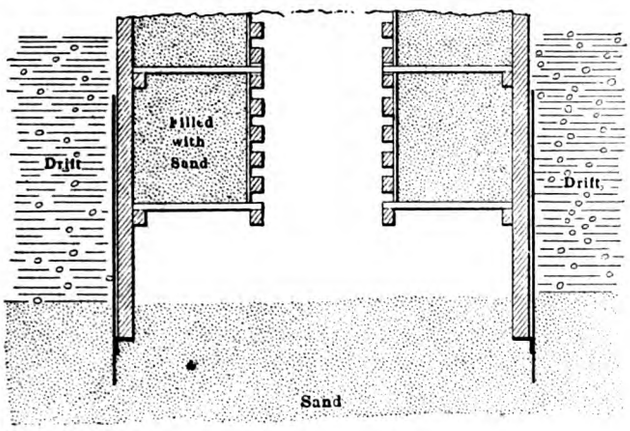
through this hole and then pumped to surface. The steel shoe was similar to the one in the main shaft, except that it was 10 ft. high instead of 5 ft. The timbering for the first 30 ft. above the shoe consisted of 4 by 6 members laid flat, tied together by ⅝-in. lag-screws 10 in. long, spaced 2 ft. apart. The shaft was divided into three equal compartments by 4 by 6 buntons. The middle compartment was left free and was used for hoisting.

An excavation 10 ft. deep was made, the shoe assembled and lined with timbers. Sinking was continued until the shoe was hung up by the friction on the sides. Then a platform was built every 5 ft. in the end compartments. These 5-ft. chambers were filled with sand to give additional weight, and sinking continued. The ground surrounding the shoe gradually broke in an oval shape. At one place it was necessary to fire a small charge of powder in order to loosen the ground sufficiently at one end of the shaft. As the shoe was sunk, timbers were added at the top of the curbing. This method of building the curb at the top is better that that of adding at the bottom since the timbers are placed more expeditiously.



DROP-SHAFT METHOD.

One difficulty experienced was to keep the bottom of the shoe level. When one side got lower than the other it kicked the opposite side outward. To right it, the lower side was blocked until the higher side caught up. This greatly reduced the trouble.

The progress through the drift material, until the sand was reached, was slower than at the main shaft. The drop-shaft went faster, however, after reaching the sand. In fact, the difficulty at that time was to keep the bottom of the shaft from moving faster than the top. When within 10 in. of the bottom of the sand, the shaft broke apart 20 ft. from the shoe. This was due to the movement of the shoe being faster than that of the top of the shaft, and to the insufficient strength of the straps connecting the top and bottom of the curb. At this point (20 ft. above the shoe) the curb separated from 6 to 8 in., and the upper part of the shaft kicked over 9 in. A temporary platform of 8 by 8 timber was put in the end compartments and time given for the upper part to settle before starting again. Sinking was then continued and the shoe landed on the solid without further difficulty, aside from hitting two small boulders at the bottom of the sand.

As the excavation was larger than necessary for an air-shaft, it was decided to cement the shaft for a distance of 28 ft. from the bottom of the shoe, in order to stop the water. A wall of cement 4 to 8 in. thick was accordingly constructed. After the cement was given time to set thoroughly, the excavation was again started in the shale and continued without difficulty to the coal. Sinking through the shale in the air-shaft cost slightly more than in the main shaft because work in the mine prevented careful supervision being given.

One difficulty, encountered in drop-shaft sinking, was in keeping the position of the shaft vertical. At one time this shaft was 2 ft. out of plumb. By regulating the movement at the bottom of the shoe, the shaft partly righted itself, until at the finish in a total depth of 63½ ft. to the shale the bottom of the shaft was 16 in. to the south and 10 in. to the east of the top.

A much larger amount of sand was removed in sinking the air-shaft by the drop-shaft method than in sinking the main shaft. This could be done without danger of a cavity forming, because the surface dirt followed the air-shaft down. When sinking through the sand was completed, the surface directly surrounding the air-shaft had caved to a depth of 15 to 16 ft. and for a distance of 20 ft. in all directions. In fact, all the shale that was removed through the remaining 92 ft. to the coal did not fill this space at the surface.

A comparison of the two shafts is shown below. The main shaft was sunk 92 ft. by the steel-shoe method, the air-shaft was sunk 82 ft. by the drop-shaft method.

	Main shaft	Air-shaft
Labor:		
Through drift material	$917	$789
Through sand	1,942	542
Through shale	1,065	1,213
	$3,924	$2,544
Superintendence	600	435
Re-timbering	1,343	....
Cementing	....	208
Total labor cost	$5,867	$3,187
Materials:		
Curbing	$1,879	$1,195
Supplies	900	643
Power, light, water, insurance, etc.	1,249	650
Total curbing, etc., cost	$4,027	$2,487
Total costs of shafts	$9,894	$5,674

CONCLUSION. There was no question of the superiority of the drop-shaft method. It made a net saving of $4300 in the total cost of the air-shaft compared with the main shaft. A saving of $2700 was effected in labor, while in the cost of materials, power, etc., the saving was $1600. A saving in time also ensued, 30 days being required to traverse the sand with the main shaft, while the air-shaft was dropped through in 17 days. The drop-shaft method seems to be the safest, most economical, and most successful that can be adopted for sinking through soft material that lies within 100 ft. of the surface.

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Sewage-Disposal Methods in Several American Cities*

By T. D. ALLIN† and R. V. ORBISON‡

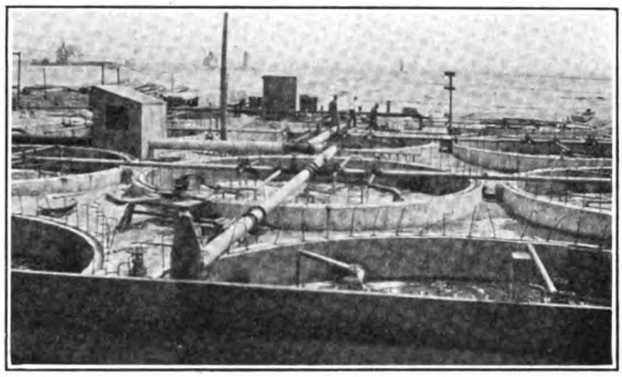
Leaving Pasadena April 29, 1916, we arrived at Houston, Texas, May 1. Here we found that the city of Houston had finished a series of tests on activated sludge, and had designed plans and was letting contracts for the construction of an activated-sludge plant. Houston has a population of 128,000, of which about 80,000 will be served with the new purification plants. The total cost of the disposal plant and outfall sewer is estimated at $378,000 or $20,000 per million gallons gross capacity.

Our next stop was New Orleans, Louisiana. This city has no purification or disposal plant—simply pumping the sewage into the Mississippi river. The pumping is necessary because the river is higher than the city. New Orleans is an example of what can be accomplished in a sanitary way, as it was only about fifteen years ago that the sanitary condition in New Orleans was a disgrace, the sewage running in open ditches, while today New Orleans is one of the cleanest cities in the United States, because of the improved sewage and drainage systems and the absolute enforcement of sanitary laws. From the collecting-basins the sewage is pumped into the river, where the high dilution gives a satisfactory way of disposing of waste.

Atlanta, Georgia. This city was of special interest to us as it has the largest and best Imhoff-tank and sprinkling-filter plant in the United States. The topography of Atlanta is such that it was necessary to construct three disposal plants to handle the sewage. The first plant visited was at Entrenchment creek, six miles south-east from the City Hall. This plant was completed June 6, 1914, and was designed for a population of 50,000. It receives the trade-waste from factories making cottolene, oils, and dyes. Entrenchment creek flows 4½ miles to South river. During dry weather the dilution with the effluent from the disposal-plant is one to two. The attendants are one foreman, two day laborers, and one night watchman.

Proctor Creek disposal-plant, the second one we inspected, was completed on August 8, 1912; it was designed for a population of 30,000. It is situated on Proctor creek, four miles north-west from the City Hall. The trade-waste treated by this plant are iron, gas-manufacturing waste, and calcium oxide from the Prestolite Gas Co. Proctor creek flows five miles from the plant to the Chattahoochee river. Its dry-weather flow-dilution with the disposal plant is about one to one. This plant also takes care of the night soil from 30,000 people. The attendants are one foreman, one day laborer, and one night watchman.

Peachtree Creek disposal-plant is situated on Peachtree creek, five miles northerly from the City Hall, and was designed for a population of 80,000. It was constructed September 8, 1913, and is similar to the other two plants, consisting of Imhoff tanks, sprinkling-filters and sludge-beds. The effluent discharging into Peachtree creek has a dilution during dry weather of one to five. From this point the creek flows about five miles to the Chattahoochee river. It handles practically no trade-waste, only iron from the iron works. This plant receives 8,000,000 gallons of sewage daily through the Imhoff tanks, but only one-half passes over the sprinkling-filters. The attendants at this plant are one chemist, one assistant chemist, three day laborers, and one night watchman. All of the control work of the three plants is done at the laboratory at this plant, where Chas. C. Hommon, the chemist, is stationed. His home is only a few yards from the plant.



GENERAL VIEW OF ACTIVATED-SLUDGE PLANT AT MILWAUKEE.

All of the disposal-plants are working well and are not causing any nuisance. Before these plants were constructed, suits amounting to $30,000 were filed against the City. None of them, however, came to trial but were all withdrawn by the time the three plants were placed in operation.

Washington, D. C. This city, like New Orleans, has made no attempt to purify its sewage, but pumps it into the Potomac river. Washington has, however, the largest sewage-pumping plant in the United States, and it is kept in excellent condition. This city has a population of 350,000, and is about 60% sewered with about 75% having water connections. Of this amount about 70% is metered. The daily water consumption is 250 to 350 gal. per capita. Washington has the combined system, using coarse bar-screens and pumping

*Summary of investigation made for cities of Pasadena, South Pasadena, and Alhambra.

†Commissioner of Public Works, Pasadena, California.

‡City engineer, Pasadena, California.

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the raw sewage into the Potomac with a dilution of 1 to 8,000,000.

Baltimore, Maryland. Baltimore's disposal-plant consists of Imhoff, hydrolytic and sludge-digesting tanks, screens, sprinkling filters, secondary tanks and sludge-beds. This plant is treating about 35,000,000 gal. of sewage daily. A portion of this plant was placed in operation during 1911. This did not include any Imhoff tanks. In August 1915, 28 circular radial-flow Imhoff tanks, were placed in operation. One of these tanks was converted into an aerating tank with a continuous flow and continuous aeration. After the effluent leaves the tanks it passes through cylindrical screens 12 ft. in diameter by 11 ft. long, using monel-metal screens with a 24-in. mesh. These screens are made at the plant and are more durable and cheaper than those originally purchased. Thirty acres of sprinkling filters are in use with 6000 Merritt and Taylor nozzles spaced 15 ft. centre to centre. The beds range in depth from 8 ft. at the upper to 9 ft. at the lower end. After the sprinkling-filter effluent has passed through the secondary tanks, it goes through a power-house, developing 200 kilowatts. It is estimated that 1785 lb. of sludge at 60% moisture is obtained from every cubic yard of wet sludge. This sludge is sold for 81c. per ton of 10% moisture, the city delivering the sludge to a drying-house erected at the plant by a company which reduces the moisture content from 60% to 10% at its own expense. The city owns 450 acres at the disposal plant, situated on the west bank of the Black river about six miles south-east from the City Hall.

The Imhoff tanks were not working in a satisfactory manner. In fact, some of them were not in operation because of their bad condition, probably caused by overloading before having been developed to the maximum capacity. The sprinkling filters were giving fine results and no nuisance. At the sewage-pumping station the screenings from coarse bar-screens amount to 6 cu. ft., at 50% moisture, per 1,000,000 gal. of sewage treated. The city is about 50% sewered.

Philadelphia, Pennsylvania. Most of the sewage of Philadelphia is being discharged into the watercourses. The remainder is treated at the disposal works on Pennypack creek, a short distance from its entrance into the Delaware river. This disposal plant, built in 1912, was designed for a population of 10,000, although only serving a population of 5000, treating about 1,250,000 gal. of sewage daily. The plant consists of screens, grit chamber, Imhoff tanks, sprinkling filters, secondary tank and sludge-bed. The final effluent is given a hypochlorite treatment for further purification, 15 lb. of lime per 24 hours is used to correct the acid in the sewage. The sprinkling-filter bed contains one acre of 5 units—6 ft. in depth of 1 to 3-in. trap rock. Taylor square nozzles spaced 10.8 ft. centre to centre are used. The sewage is fresh when it reaches the disposal plant and the results are satisfactory.

Plainfield, New Jersey. Plainfield with a population of 20,000 is at present constructing a modern purification plant, consisting of Imhoff tanks, sprinkling filters, secondary tanks and sludge-beds. The Imhoff tanks are designed for a population of 40,000, or 4,000,000 gal. daily flow. One and three-quarter acres of sprinkling-filter beds 6 ft. deep will treat the Imhoff effluent. The former method of handling the sewage was through screens, septic tanks, contact beds, and sludge-beds. This method was not satisfactory and the new plant was designed and is now constructed to remedy this.

Fitchburg, Massachusetts. Fitchburg, with a population of 44,000, has an average daily flow of 3,500,000 gal. and a dry-weather flow of 2,500,000.

The city has a modern and successfully operated plant, consisting of grit-chambers, rectangular Imhoff tanks, dosing-tanks and two acres of sprinkling-filter beds in one enclosure, with 16 separate feeding-pipes so arranged as to cut out about 8-ft. portions of the beds at a time. This bed is 10 ft. deep with the lateral distributors near the surface, using the Worcester nozzle. Following the sprinkling-filter beds are the secondary Imhoff tanks, circular with a radial flow. The sludge from the secondary tanks is pumped back to the preliminary Imhoff tanks, while the preliminary-tank sludge is lifted into the drying beds just above the tanks. There are two dosing-tanks with a capacity of 45,000 gal. each, operated by siphons under a head of from 3 to 8 ft. With a five and a half minute discharge and a 3,000,000-gal. flow the cycle is 36 minutes. Fitchburg has a combined system with a grit chamber in town. It costs about $2 per cu. yd. to clean this chamber. The time of flow between the centre of the city and the effluent from the secondary tanks is between 6 and 7 hours. Dilution in the stream is about two to one, except in summer, when the creek is practically dry. The city owns 120 acres, but is not using all of it at present. The sludge is used for filling in low ground and does not bring a revenue. The attendants are a chemist, assistant chemist, and three laborers.

Brockton, Massachusetts. This city has a population of 63,000, is about 85% sewered, and has an average daily sewage flow of 2,250,000 gal., with a separate system. Trade wastes are from the tanneries and shoe factories. The sewage is run first through coarse screens, then through a Wiend screen and then pumped about three miles to the purification works, consisting of sprinkling filters, secondary tank and sand filters. The cost of operation at the pumping-plant and screens is $30,000 a year, and at the disposal works $10,000 per year. The screenings from the Wiend screen are collected in bags and are de-watered by the centrifugal process, requiring about four minutes. The screenings amount to 5000 lb. daily. The sewage is septic when it reaches the pumps. These pumps have been in service for 22 years. The sprinkling-filter beds have an area of ½ acre, and an average depth of 6½ ft., under-drained with half-tile, the distributing laterals spaced 14 ft., centre to centre, and risers 12½ ft. staggered, using Merritt and Taylor nozzles. Sewage is applied at the rate of

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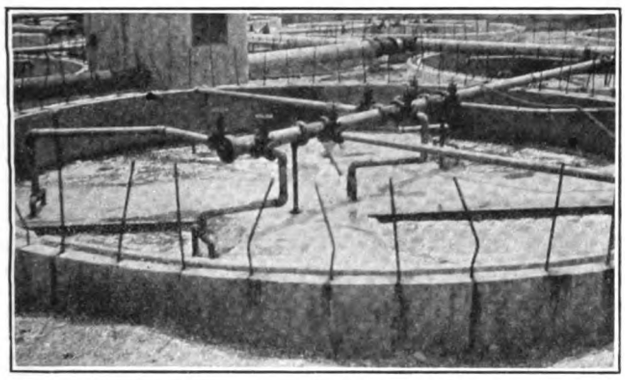
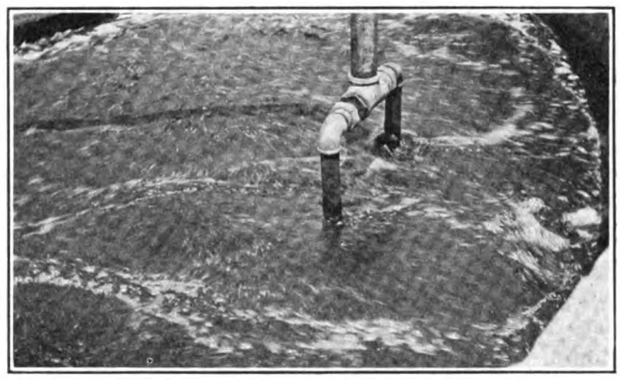
900,000 gal. per day. The sprinkling-filter bed is operated with butterfly valves. There is a plain secondary tank, 4½ by 50 by 100 feet.

There is in operation at the purification works, an activated-sludge testing-tank which Robert S. Weston of Boston is using as a clarifier only. This tank is 8 by 10 by 10 ft., using sixteen 12 by 12-in. filtros plates. Air is used at the rate of 1.8 cu. ft. per gallon of sewage treated minimum, to 2.25 cu. ft. maximum, with 25% sludge. The results from the tests are satisfactory.

Worcester, Massachusetts. Population 170,000, with a combined system. The average daily flow is about 100 gal. per capita. The city disposes of its sewage by chemical precipitation, septic tanks, and 72.6 acres of sand-filters. The sludge is pressed and hauled to a dump where farmers take all they want. The remainder is used for filling low ground. Owing to the growth of population and the increased cost of sand-filters, this city will have to adopt other methods for the purification of its sewage. With this in view, experiments have been made with Imhoff tanks and sprinkling filters. It is their intention to test the activated-sludge process in the near future.



TANKS FOR ACTIVATED-SLUDGE PROCESS.



AIR BEING FORCED THROUGH SEWAGE IN ACTIVATED-SLUDGE PROCESS.

Rochester, New York. In 1915 there was constructed and placed in operation a disposal plant to handle the sewage from the Brighton district. This plant consists of screen and grit chambers, Imhoff tanks, sprinkling filters, secondary tanks and sludge-beds. Before the screened sewage enters the Imhoff tanks, it is passed through Pelton wheels with a head of 69 ft. It is possible to develop 6 hp. for each second foot of sewage. Each wheel is belted to a 10-kilowatt direct-current generator, and the power is used to light the plant and run the cranes.

The Imhoff tanks have a sludge capacity of 1.84 cu. ft. per capita for four months. The screens and grit-chambers are designed for a population of 25,000 and the balance of the plant for 10,000. The average daily flow of domestic sewage is estimated at 100 gal. per capita, with an infiltration as high as 300 gal. per capita.

Rochester is now constructing a disposal works consisting of grit-chambers, Riensch-Wurl screens, Imhoff tanks and sludge-beds, which will serve that portion of the city not included in the Brighton district. This plant is designed for a population of 430,000 and will have a capacity of 55,500,000 gal. daily with a combined system. The effluent will be discharged into Lake Ontario.

Batavia, New York. This city has a population of 13,000 and an average daily flow of sewage of 2,000,000 gal. The plant consists of Imhoff tanks, sprinkling filter and sludge-beds. The filter area is one-quarter of an acre, and is being dosed at the rate of 8,000,000 gal. per acre. The results are satisfactory, even though the filter-bed is overloaded.

The sludge has been used to fill in the low land around the plant and the superintendent's home (which is only 40 ft. from the sludge-beds). The superintendent told us that neither he nor his family have ever been bothered with odors from the plant.

Cleveland, Ohio. Cleveland's sewage at present is simply screened and the effluent discharged into Lake Erie. They have, however, an activated-sludge testing-plant designed to handle 750,000 gal. of sewage daily. This plant complete cost about $15,000 and is of sufficient size to enable them to work out their problems on a large scale.

Canton, Ohio. This city has a population of 60,000 and is entirely sewered. They have a combined system with a daily flow of 2,500,000 to 5,500,000 gal., with a maximum of 6,000,000 gal. The sewage flows six or seven miles through a segment-block sewer to the purification works consisting of coarse bar-screens, grit-chamber, Imhoff tanks, contact beds and sludge-beds. There are two rectangular Imhoff tanks, and each tank has three units of three compartments, designed for a future population of 120,000. The contact beds contain 7.23 acres, 6 ft. deep, using crushed slag and washed gravel for the filter material. The sludge-beds are in two units of three sections each, one unit being covered with a glass house to facilitate the drying of sludge during rainy weather. The disposal works cost $260,000 and the outfall sewer cost $200,000.

Columbus, Ohio. In 1908, Columbus constructed a disposal plant consisting of screens, septic tanks, sprinkling filters and final settling-basins. This plant was designed for a population of 200,000 and a daily

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dry weather flow of 20,000,000 gal. Today, with a population of about 225,000, they are remodeling the septic tanks into Imhoff tanks and adding sludge-beds. Ten acres of sprinkling-filter beds are now in use.

Mount Vernon, Ohio. Population 10,000. The sewage from this city is passed through coarse bar-screens, then through Imhoff tanks and the effluent turned into Owl creek without further treatment. Dilution in the creek at extreme low water is about 1 to 20. The Imhoff tanks are rectangular, 27 by 30 by 80 ft. The sludge-bed has a capacity of 562.5 sq. ft. per 1000 inhabitants.

Chicago, Illinois. The sanitary district of Chicago is experimenting with activated sludge on the packing-house sewage, and they are getting satisfactory results, although the quantity of air that is being used per gallon of sewage treated is rather high when compared with that of other cities. On the other hand, the stock-yard sewage is more difficult to handle than any other sewage known, unless it be sewage containing tannery wastes. The fill and draw method was started in January with 20% sludge, and shortly afterwards changed to the continuous-flow process, using from 5 to 6 cu. ft. of air per gallon of sewage treated. This tank has a capacity between 30,000 and 100,000 gal. daily.

Milwaukee, Wisconsin. After conducting numerous experiments, Milwaukee has constructed and put into operation an activated-sludge plant designed to handle 2,000,000 gal. of sewage daily. At present they are only treating 1,200,000 gal. per day, using 25% activated sludge, four hours aeration, a settling period of about 40 minutes and 0.25 cu. ft. of air per minute per square foot of tank surface, or 1.77 cu. ft. of air per gallon of sewage treated with the air at 5 lb. pressure. This gave an effluent containing no suspended solids, stable after 5 days and a bacterial reduction of over 98%. The remarkable features of Milwaukee's plant are the total absence of odors and the high degree of purification at a reasonable cost.

Mason City, Iowa. This city has a population of 20,000 and a daily average sewage flow of 600,000 gal., or 30 gal. per capita per day. The purification plant designed and under construction to handle this sewage consists of Imhoff tanks, sprinkling filters, secondary tanks and sludge-beds. This plant is designed for 1,000,000 gal. per day. The Imhoff and secondary tanks are rectangular. The filter-bed contains one acre, and is 8 ft. deep with the Taylor square nozzle spaced 11 ft. centre to centre. Both the tanks and filter-bed are roofed with steel roofing, using pebble-dash finish with white Medusa cement. The sludge-bed capacity is 270 sq. ft. per 1000 inhabitants. The total cost of the plant will be $140,000, or on the basis of the present population, $7000 per 1000 inhabitants.

Summary—After a careful study of the various methods of sewage purification used in the United States, and the results accomplished, we come to the conclusion that Imhoff tanks, followed by filtration and sludge-beds, and, in some cases, secondary tanks, if properly designed and operated, give the best results of any process that is in use today, with the exception of activated sludge. There are numerous plants of the former type in operation today, serving from a few hundred inhabitants up to 160,000, in the case of Atlanta, Georgia. In all cases where the plants were properly designed and operated, satisfactory results were obtained. On the other hand, such excellent results have been recorded in the past 18 months with activated sludge, that it seems probable that it will eventually supersede all other methods where a high degree of purification is necessary. The results obtained at Milwaukee and elsewhere have proved beyond a doubt that the degree of purification depends principally upon the amount of air used.

The consensus of opinion of our most eminent sanitary engineers and health officers who had investigated, and with whom we conversed, was that the effluent from activated sludge was the most perfect of any process now known, but some expressed doubt as to its being possible to handle the sludge without odor, owing to its high fertilizing value, and on account of its high proportion (about 98%) of water. By the application of a press to dewater the sludge, as is used at Milwaukee, there is no question as to handling without odor. We have a sample of sludge which we took from the press at Milwaukee on June 1st, which has been absolutely free from odor at all times since that date. In the dry warm climate of southern California we believe it possible to dry the sludge in beds without obnoxious odors, but believe the press should be used if a plant be near inhabited area.

At no Imhoff plant visited were odors to be detected at a distance greater than 200 ft. from the plant, and in most cases the distance was less than 200 ft. While some plants showed better design and better maintenance than others, the Atlanta plants, by reason of their size and excellent maintenance were the most interesting plants of the Imhoff type, but the Fitchburg plant and the Batavia plant, although much smaller units, were giving most excellent results. The Fitchburg, Batavia, and Mt. Vernon plants of the Imhoff type in operation were the most conspicuous by close proximity to habitation. At Fitchburg, good residences were at a distance of about 750 ft. from the plant, at Batavia, 380 ft., and at Mt. Vernon, about 500 ft. with a paved street and a population of about 500 living in good homes within one-fourth mile. Mason City, Iowa, is constructing its plant within one-fourth mile of good residences.

There were no odors escaping from the activated-sludge plants. Cleveland was using this process within 300 ft. of high-class residences. By comparing the activated sludge process with Imhoff tanks and sprinkling-filter process, we find that the former occupies less space, costs less for construction, gives a better effluent, and is absolutely odorless. The cost of operation, however, is greater than with the latter process, but its sludge has a higher fertilizing value, and the revenue derived from its sale will reduce the difference in cost of operation.

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Engineers for the Officers' Reserve Corps

By A. H. BABCOCK

The great struggle in Europe emphasizes the lack of officers available for the augmented English Army, and therefore conveys a solemn warning to the American people: the English Army and the United States Army being based on much the same organization, namely, a skeleton in peace times, to be increased as may be required in war time.

"The almost studied indifference of the American people toward reasonable preparation for the contingency of war makes more urgent the duty of all officers or those who hope to become officers, to do all in their power in advance to prepare themselves and those committed to their care for the immense responsibilities that will rest upon them when the storm bursts upon the nation.

"The trend of history shows in general a progressive decrease in the length of wars due to the enormous massing of men now possible, and the increasing power of destruction of modern weapons. The decision, in short, is sooner reached. This being the case there is more than ever before a need for adequate preparation in advance of the outbreak of war. The unprepared people or government who now-a-days find themselves on the brink of hostilities with a nation that is trained for the struggle, must expect inevitably to pay a severe national penalty.

"The preparation of a nation for war is of two kinds: one of material things, the construction of forts, arsenals, fabrication of weapons, munitions, etc., the other the training of its people. And the second is more important than the first, though in the United States the estimate of their relative importance is reversed. The people of the United States are willing to vote immense sums for preparations that concern material, but they grudge time or thought devoted to the war training of the fighting unit—the man."*

On the third of June, 1916, Congress passed an Act "for making further and more effectual provisions for the National Defense." Regulations prescribed by the President to carry this into effect have been published by the War Department, General Orders No. 32, from which the following is largely abstracted. The Officers' Reserve Corps has been created for the purpose of securing a reserve of trained men available for service as temporary officers in the Regular Army. A member of this Officers' Reserve Corps will not ordinarily be subject to call for service in time of peace. It is expected, however, that reserve officers will be ordered to duty with the troops or at field exercises or for instruction for periods not to exceed 15 days in any one calendar year, and while so serving they will receive the pay and allowances of their respective grades in the Regular Army.

*'Technique of Modern Tactics,' Bond & McDonough.

The act authorizes the President "to appoint and commission as Reserve Officers in the various sections of the Officers' Reserve Corps, in all grades up to and including that of Major, such citizens as, upon examination prescribed by the President, shall be found physically, mentally, and morally qualified to hold such commissions." The age-limits fixed for appointment and re-appointment are, for a Second Lieutenant, 32 years; a First Lieutenant, 36 years; a Captain, 40 years; a Major, 45 years. These age-limits shall not apply to the appointment or re-appointment of officers in the Quartermaster, Engineer, Ordnance, Signal, Judge Advocate, and Medical sections of the Reserve Corps.

Commissions will be issued for periods of five years; and when an officer of the Reserve Corps shall reach the age-limit fixed for appointment or re-appointment in the grade in which he is commissioned, he shall be honorably discharged from the service of the United States (unless re-commissioned in a higher grade).

In time of actual or threatened hostilities, the President may order officers of the Reserve Corps to temporary duty with the Regular Army, in grades thereof which cannot for the time being be filled by promotion; or as officers in volunteer or other organizations that may be authorized by law; or in such other duty as the President may prescribe; for example, the recruit, rendezvous, and supply depots. While on such service the reserve officers, by virtue of their commissions as such, will exercise command appropriate to their grade and rank in the organizations to which they may be assigned, and shall be entitled to the pay and allowances of the corresponding grades in the Regular Army, with such increases of pay as are allowed by law for officers of the Regular Army; and they may be promoted, in accordance with their rank, to vacancies in volunteer organizations or to temporary vacancies in the Regular Army thereafter occurring in the organization in which they shall be so serving, but they shall not be entitled to retirement or to retired pay and shall be entitled to pension only for disability incurred in the line of duty and while in active service.

The Sections of the Officers' Reserve Corps shall be designated as follows:

"1. Infantry Officers' Reserve Corps.
2. Cavalry Officers' Reserve Corps.
3. Field Artillery Officers' Reserve Corps.
4. Coast Artillery Officers' Reserve Corps.
5. Medical (to include the reserve officers of the Medical Corps, Dental Corps, and Veterinary Corps) Officers' Reserve Corps.
6. Adjutant General's Officers' Reserve Corps.
7. Judge Advocate General's Officers' Reserve Corps.

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8. Inspector General's Officers Reserve Corps.
9. Quartermaster Officers' Reserve Corps.
10. Engineer Officers Reserve Corps.
11. Ordnance Officers' Reserve Corps.
12. Signal Officers' Reserve Corps."

Every applicant will be subjected to a rigid physical examination and he will be rejected for any cause of disqualification that in the future might impair his efficiency as an officer; but defects of vision resulting from errors of refraction, which are not excessive and which may be corrected by glasses, do not disqualify unless they are due to organic disease. In general the examination as to physical qualifications will conform to the standard required for recruits in the United States Army. Before making the examination the applicant will be required to submit, for the examination of the Board, a certificate as to his physical condition, which, in case no disqualification exists, will be a simple signed statement from the applicant that to the best of his knowledge and belief he is not affected with any form of disease or disability that will interfere with his proper performance of the duties under the commission for which he is applying.

No applicant will be examined who is an officer of the Regular Army on the active list, or of the National Guard, or who is not a citizen of the United States. The lower age-limit below which examinations will not be made is, for the Second Lieutenant, 21 years.

The examinations in all subjects will be oral or practical, or both; but in certain cases applicant is authorized to call for a written examination, if he so desires. Emphasis is laid upon the fact that the examination shall be specially directed to ascertain the practical capacity of the applicant, and the record of his previous service and training shall be considered a part of the examination.

Engineers, as such, are interested more particularly in the Coast Artillery, Quartermaster, Engineer, Ordnance, and Signal Corps. As a guide to the preparation required, examinations in the Coast Artillery Corps will refer to Army Regulations and important General Orders, Drill Regulations, Field Service Regulations, Explosives, Electricity. For the higher grades of the service this examination will include, in addition to the foregoing, elementary and applied mechanics, care and operation of steam-boilers, steam-engines, and internal-combustion engines; the theory, care, and operation of dynamos, storage-batteries, telephones, and searchlights; from which it would appear that both mechanical and electrical engineers should be largely interested in the Coast Artillery work.

For the Engineer Corps the applicants will be divided into two classes:

"(*a*) For duty with combatant engineer troops, or other duties in the service of the front; or

(*b*) For special service on the lines of communication or other points in rear, including engineer work with sea-coast defenses as hereinafter indicated."

Ordinarily, officers appointed under (*b*) will not be assigned to combatant duties, but they will be subject to such assignment whenever needed. The reasons for this provision will appear later, when the responsibilities of the engineer officers under the two classes are considered.

Under (*a*), Service of the Front, an applicant for a commission as First or Second Lieutenant must be an engineer in the active practice of his profession or in some business immediately connected with or concerned in engineering matters. He must either hold or have qualified for the grade of Junior Engineer—civil, electrical, or mechanical—or of some higher grade in the Civil Service, or he must be a graduate from an approved engineering college or have been in the active practice of engineering for at least two years.

An applicant for a commission as Captain, in addition to the requirements for Lieutenant, must either hold or be eligible for the grade of Assistant Engineer in the Engineering Department at Large, or a corresponding engineer grade in the Civil Service or another Department of Government Service, or have held a commission in the Corps of Engineers of the Regular Army; or he shall be a professional engineer not less than 28 years of age, who shall have been in the active practice of his profession for at least eight years and have had responsible charge of work, as principal or assistant, for at least two years; he must have knowledge of the principles of Military Organization and Operations, in Infantry Drill and Field Service Regulations, and of the general principles of Field Fortifications as illustrated in the Engineer Field Manual.

For Major, in addition to the requirements for Captain, he must have held a commission in the Corps of Engineers of the Regular Army, not more than two grades below that for which he desires to be listed; or he shall be a professional engineer not less than 35 years of age, who shall have been in the active practice of his profession for 15 years, who shall have had responsible charge of work for at least five years and he shall be qualified to design as well as to direct engineering work. Furthermore, he must have knowledge of the duties of engineer officers and troops in war, as illustrated in the Engineer Field Manual, and in certain other publications mentioned in the Act. Under class (*b*), Special Services, he must be qualified for at least one of the duties assigned to the Corps of Engineers by the following extracts from Army Regulations:

"The duties of the Corps of Engineers comprise reconnoitering and surveying for military purposes, including the laying out of camps; selection of sites and formation of plans and estimates for military defenses; construction and repair of fortifications and their accessories; * * * the installation of electric power-plants and electric power-cable connected with seacoast batteries; * * * construction and repair of military roads, railroads, and bridges; military demolitions; * * * In time of war within the theatre of operations it has charge of the location, design, and construction of wharves, piers, landings, store-houses, hospitals, and other struc-

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tures of general interest, and of the construction, maintenance, and repair of roads, ferries, bridges, and incidental structures, and of the construction, maintenance, and operation of railroads under military control, including the construction and operation of armored trains."

"No oral or professional examinations will be required, but recommendations of boards will be required in lieu of such examinations. Candidates will submit evidence of their actual employment in corresponding or higher positions in civil life and references to persons under whom they have been or are employed. The boards will communicate with such persons and with any others that they deem fit, and upon all the evidence submitted or otherwise obtained will base their recommendations and recommend the appropriate grades for which they deem the successful candidates qualified.

"Military experience or training in the Regular Army, Volunteers, or National Guard, or at training camps or educational institutions will be noted and reported by the board and considered in making the recommendations.

"Reserve officers from the following civilian occupations will be required for the special services of the Corps of Engineers:

Bridge engineers.
Constructing engineers (earth and concrete).
Constructing engineers (wharves, piers, and buildings).
Electrical engineers (for small plants and power-lines).
Highway engineers.
Mining engineers (skilled in tunneling and use of explosives).
Railroad engineers (construction and maintenance).
Railroad operating officials.
Sanitary engineers.
Topographical engineers."

Engineers of telephone and telegraph companies will be directly interested in the Signal Corps, examinations for which, in the lower grades, will include the same administration subjects as for the Infantry officers; also regulations and laws pertaining especially to the Signal Corps. They will be examined both orally and practically in theoretical and practical knowledge of modern methods of visual signaling, including the ability to transmit and to receive messages by flag, lantern, and heliograph.

Telegraphy and telephony include theoretical and applied knowledge of electricity and telegraphy, covering installation and repair of telephones, testing for faults, maintenance and operation of permanent telegraph, telephone-lines, and of field-lines; skill in transmission and receipt of messages on telegraph-lines; oral and practical examinations concerning dynamos and batteries, also radio-telegraphy. They will be required to have some knowledge of map-reading and field-sketching.

For Majors the examination will be the same as the foregoing, but in addition they will be required to show knowledge as to material, cost, time, etc., and method of constructing a permanent telegraph-line in such portion of the United States as may be designated; knowledge of a scheme for assembling, organizing, and transporting a mobile telegraph-train for building light semi-permanent lines for telegraph or telephone communication under conditions to be designated by the Examining Board. They will be required to have a knowledge of engines, boilers, internal-combustion engines, and automobile traction.

For the special services in the Aviation Section, Reserve officers selected from civilians engaged in the following occupations will be needed: Aviators, aeroplane designers, motor designers, experts in aero-photography and radio-communications, aeronautical engineers and balloonists.

Probably the section of the Reserve Corps of most general interest will be the Quartermaster Corps, to qualify for which an applicant will be examined for duties that require either a knowledge of administrative and clerical detail, or for special services of a business or professional nature requiring no special military knowledge. The first class will receive a mental examination to test their fitness for the peculiar services required; the second class will not be subject to mental examination, and, as has been stated previously, neither class is subject to age limits, but both are subject to physical examination.

In the first class the scope of the examination will cover general duties as exemplified in the United States Army Transport regulations and circulars of the Quartermaster General's Office relating to supplies, payment and services, subsistence, and pay manuals. The applicant will be furnished blanks and will be required to exemplify their use in the preparation of contracts, bonds, returns, accounts current, etc. Military Law; oral examination will cover the ground of Manual of Court's Martial, the Law of War, Civil Functions and Regulations of the Military, and General Instructions for the Government of the Armies of the United States in the Field; also on the Cavalry Horse, Draft Horses and Mules—their inspection and purchase, care, feeding and watering; also the construction, lighting, and ventilation of stables; the different kinds and relative value of forage, its inspection, proper care and causes of deterioration; also on transportation by land (rail, wagon, and pack) and by water; the care of animals on cars and transports; construction and repair of roads, railroads, and bridges.

For those whose duties are not administrative there will be required merely a knowledge of and experience in one of the trades or lines of business, as follows:

"Railroad—
(*a*) Traffic manager, commercial.
(*b*) Accounting department, railroad.
(*c*) Operating department, railroad.
(*d*) Mechanical department, railroad.
(*e*) Other capacity, not named above, railroad.

"Navigation companies and merchant vessels—
(*a*) As manager.

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(*b*) As port captain.
(*c*) As superintending engineer.
(*d*) As chief steward.
(*e*) As marine superintendent.
(*f*) As inspector of construction and repairs.
(*g*) As estimator on marine repairs.
(*h*) As superintendent of docks, warehouses, etc.

"Auto-truck transfer companies.
"Auto-truck freight companies.
"Warehouse and terminal companies.
"Animal industry—
(*a*) Purchasing horses and mules.
(*b*) Shipping horses and mules.
(*c*) Breeding and raising horses and mules.
"Wholesale feed and grain business.
"Wagon, machine, or other factories.
"Harness factory.
"Auto-truck repair-shops or factories.
"Automobile repair-shops or factories.
"Ship construction or repair firms.
"Wholesale grocery business.
"Wholesale clothing business.
"Wholesale shoe business.
"Clothing manufactory.
"Shoe manufactory.
"Hat manufactory.
"Auto-truck manufactory.
"Packing-houses or factories.
"Shop management and its nature.
"Official of large restaurant or hotel company.
"President, secretary, or manager of any large business, whatever its nature.
"Official of any department of a large business.
"Building company.
"Construction company.
"Civil engineering.
"Mechanical engineering.
"Sanitary engineering.
"Electrical engineering.
"Structural engineering.
"Banks or banking firms or corporations.
"Financial or cashier departments of railroads or other transportation companies, corporations, or other large business concerns.
"Any other industries or business not mentioned above that may make the applicant a desirable officer of the Quartermaster Corps in time of war."

The Examining Board will carefully consider the documentary evidence furnished by the applicant, and it may acquire additional information by personal questions as to his business experience and other pertinent matters. The Board may call also for additional documentary or oral evidence bearing on the suitability of the applicant for his commission.

Railroad officials and engineers are particularly interested in the distinction between the Engineer Corps and the Quartermaster Corps as applied to railroading. In time of war (actual or threatened), the Federal Government undoubtedly will take charge at once of all railroads in or near the threatened territory, which will be divided into two sections, namely, the theatre of operations and the lines of communication, which, in general, is the connecting link between the field of action and the base, and through which must pass all of the men, materials and supplies required for use in prosecuting the campaign.

A railroad involved in the theatre of operations is managed and operated by the Engineer Corps; a railroad outside the theatre of operations, but involved in the line of communications, is operated by the Quartermaster Corps. Any railroad so involved must expect in such times to have on its staff, officers responsible to the War Department in either one of the corps mentioned, to represent the Department in its operation. If a sufficient number of railroad officials qualify for duty and are commissioned in the Officers' Reserve Corps in either of the sections named, the only change in its personnel that it may expect will be to see certain of its officers in army uniform instead of in civilian clothes; and conversely, a railroad in which there is insufficient representation in the Officers' Reserve Corps may expect to find army officers detailed to take charge.

When the close inter-dependence between all public utilities is considered, transmission companies and communication companies may expect to have similar situations confront them. It would appear, therefore, prudent, as a part of the general preparedness movement, that all public utility companies should encourage their officers to apply and to qualify for commissions in the Reserve Corps, and thereby insure to the companies a minimum of disturbance in administration in case of hostilities.

Engineers now have offered to them their opportunity to give their services to their country most effectively, when she will have most need of them, with the assurance that they will be given responsibility and rank commensurate with their experience and ability. Some hard digging is involved for those who have not had military training or who have forgotten much of their early experiences. The Army officers who have in hand the instruction of reserve officers do not expect us to be experienced; they expect to give us experience. All they ask of us is to be willing to learn and to give up some of our spare time to this end. In return we are assured of preferred opportunity to obtain a commission in the Regular Army, when the Army needs us, with rank and corresponding pay while on duty, appropriate to our abilities and responsibilities.

Furthermore, these same officers have given assurance that the preliminary examinations are not to be designed to keep men out of the service, but to help them to get in most effectively, that is, where they fit best. Once entered, it is up to the individual to go ahead or to stand still.

The question may be asked, why do it at all? The answer is: if there is real trouble there will be enough to go around—which means that every man will have "to do his bit."

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Methods and Costs of Construction of Part of Winnipeg Aqueduct

By H. L. TILLEY*

In a recent number† I gave a general description of the Winnipeg aqueduct and a somewhat detailed discussion of the plant and methods and costs of construction on the Prairie and Brokenhead sections. The present article will describe the construction of the aqueduct at Camp No. 1 on Contract No. 32. This work is being done by the Winnipeg Aqueduct Construction Co., Ltd., of Winnipeg. William Smaill is general superintendent for the company, George F. Richan is resident engineer for the water district, and I am general foreman on the work.

The conditions encountered on Contract No. 32 are similar to those on Contract No. 31, described in the previous article as far as nature of surface, character of excavation, and amount of water to be handled are concerned. The design of the concrete conduit is also practically the same. The construction plant used on Contract No. 32 is, however, quite different from that on Contract No. 31.

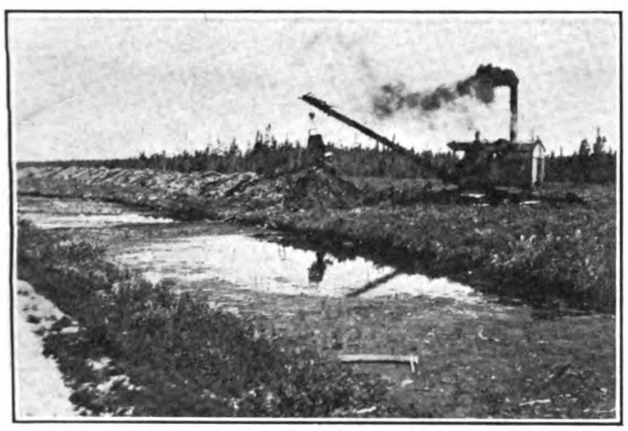

FIG. 1. DRAG-LINE EXCAVATOR DIGGING TRENCH.

For the excavation, a Type No. 7, 1¼-yd. 45-ft. boom Bucyrus dragline machine is used. The upper part, comprising the majority of the excavation, is soft muskeg, which, in places, will hardly support the weight of a man. The drag-line excavator is carried over this muskeg on pads made of seven 4 by 10-in. by 18-ft. timbers, bolted together by cross-ties of 8 by 8-in. timbers. Bolted to the base of the machine are 6 by 14 in. by 14-ft. fir shoes, faced on the wearing side with 6 by 6-in. oak. These shoes roll on 6-in. iron-pipe rollers, 4 ft. long and filled with wood, thus carrying the machine over the pads. Chains hooked over the side of the bucket and into U-bolts through the pads serve to lift the pad from the rear and to place it in front of the machine when moving. To prevent the machine from rolling while digging, a chain is hooked to an eye-bolt in the skid and into a U-bolt in the pad; or else wooden chocks are placed under the rollers for this purpose. In moving ahead, all that is usually necessary is to drop the bucket ahead in firm ground or under a root, remove the chocks or chains, and pull on the drag-cable.

FIG. 2. PLACING CONCRETE FOR INVERT.

The drag-line crew consists of a runner, fireman, and two pad-men, working a single ten-hour shift all the present season except for about ten days. We started excavating on April 27 and on July 25 had completed 12,200 lin. ft. of trench. The average cut was 3½ ft. and the total excavation from the trench, 28,262 cu. yd. While making the trench, the machine also excavated 24,074 cu. yd. from a continuous borrow-pit. The borrow-pit excavation was made to complete a dump 11 ft. high, and of sufficient width for a road-bed for the concrete dinkey-train shown in Fig. 2 and 3.

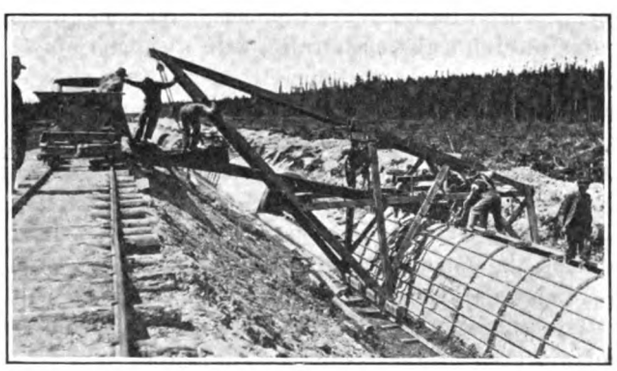

FIG. 3. PLACING CONCRETE IN ARCH.

The drag-line machine leaves about six or eight inches of excavation in the trench to be removed by hand. This work is left purposely until just before the invert-forms are set, so as to have the invert bottoms dry and

*Superintendent for Winnipeg Aqueduct Construction Co., Winnipeg, Canada.

†WESTERN ENGINEERING, Vol. VII, p. 139.

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firm at the time of placing the concrete. The hand excavation generally consists of 'muck' and sticky clay. It must be trimmed to a neat grade and to a concave cross-section, making this part of the work expensive. The contract price for ditch excavation is $0.55 per cu. yd. On an average 83% of each shift has been spent in digging, 12% in moving head, and 5% on repairing. The average rate of wages is $0.2625 per hour, and the labor obtainable is usually inefficient.

The price named for concrete on Contract No. 32 is $9.90 per cu. yd. Aggregate properly mixed for concrete is delivered by the Water District to the contractor's bins at $0.75 per cu. yd., as on Contracts No. 30 and 31. Cement is supplied by the Water District. The concrete-plant consists of a gravel-bin, a stationary ¾-yard batch-mixer, and an industrial railroad for transporting concrete. The mixer is operated by steam and is mounted 7 ft. above the ground. A plank platform 12 ft. wide is laid along side of the district railroad, 200 ft. each way from the mixer, to receive the aggregate from the district's side-dump cars. From this bin, the aggregate is shoveled into side-dump cars and pushed to the mixer on the same industrial track that is used for concrete transportation. A Plymouth gasoline dinkey-engine pulling a three-car train, with a capacity of four 18-ft. batches, hauls the concrete on a 3 ft. 2 in. gauge industrial track. The maximum haul is ½ mile each way from the mixer. From this train, the concrete is dumped into chutes which deliver it to the centre of the 15-ft. invert section. The concrete is spread by hand. A 3-in. angle-iron 16 ft. long, handled by two men is used to bring the concrete to a uniform surface. (See Fig. 2). It is then floated and troweled to a sidewalk finish.

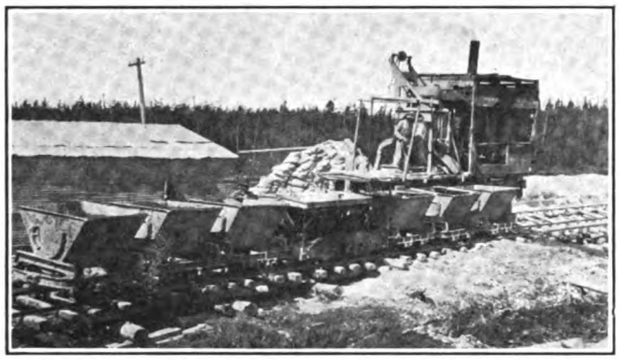

FIG. 4. CONCRETE MIXER AND DUMP CARS.

FIG. 5. TRAVELING CARRIAGE FOR ARCH FORMS.

Blaw collapsible steel forms are used for pouring the concrete arch of the conduit. These forms, moved in 45-ft. sections, are carried by a steel-frame traveler, which runs on a 2-ft. gauge track laid with 20-lb. rails. The rails are laid on 4 by 4 in. by 3 ft. timbers which rest on the concrete invert. On top of this traveler is fastened a channel-iron which supports jacks that carry the forms. Eight turnbuckles, hinged one end to the frame of the traveler, and the other to the ribs of the forms, serve to pull the forms away from the concrete to permit their removal. These turnbuckles also serve for bringing the sides of the forms into alignment after they are moved in place for another pouring. When a section of inside forms has been placed and aligned, steel bulkheads holding the copper expansion-strips are securely bolted to it, and stay-blocks of 4 by 4-in. timber are placed inside, resting one end against the base of the form, and the other against the 4 by 4-in. tie of the traveler-track. The outside forms are also handled and set up in 45-ft. sections by means of a traveling-frame of special design, which rolls on a track laid on each side of the arch. (See Fig. 5). The gasoline dinkey-engine pulls the carriage and load with ease and speed at the end of an 80-ft. cable. The engine that is used for transporting concrete is used at odd times for this purpose.

Fig. 3 shows the concrete being placed in the steel-arch forms through a steel chute held in place while pouring, and transferred from arch to arch by a portable timber frame of special design. This carriage travels on the same track that is used by the steel-form traveler. A system of ropes, pulleys, and windlasses is used for adjusting the length of the chute and also for lifting it free for moving. This device was designed by Mr. Smaill and has proved to be a practical arrangement that can be adjusted and moved quickly and easily. Between May 23 and September 30, 1916, 7125 cu. yd. of concrete has been placed in the conduit, which runs 8 cu. yd. to the lin. ft. Wages range from $0.25 to $0.30 per hour and the labor obtainable is mostly inefficient.

The concrete crew consists of a mixer engineer and his helper, one foreman, one man charging the mixer with cement, an average of 8¼ men shoveling aggregate, 2½ men transporting concrete, 4¾ men transporting concrete, moving the chute, etc., 2½ men setting invert-forms. and 2¾ men finishing. One foreman, six steel-form men, and four helpers clean, oil, set, and remove the Blaw arch-forms, and also take up and move the track.

Fig. 2 and 3 show the elevation above the surface required for the concrete train. When there is sufficient cut in the trench, as there is on many other parts of the work, a borrow-pit is not required to make the embankment for the dinkey-engine. This borrow-pit, which is placed on one side of the trench, provides material for elevating the track for the concrete-train and also for backfilling the trench. Backfilling to a depth of 4 ft. 6 in. over the top of the conduit is required. A limit is placed upon the depth allowed for a borrow-pit on each

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side of the conduit so that when the cut is small, a borrow-pit on both sides is necessary in order to get enough material for the backfill. The drag-line excavator used for digging the trench is also used for backfilling over the conduit after the season's excavation is completed. A sufficient amount of material being deposited on one side of the trench as the excavation proceeds makes it possible for the machine to backfill from one side as it returns, thus saving a trip down the other side of the conduit. The contract price for backfilling is $0.25 per cu. yd. The backfilled embankment is to be sodded and seeded, for which the contract price is $100 per acre. Other prices the contractor receives on minor parts of the work are $12 per cu. yd. for concrete in culverts, $0.05 per lb. for reinforcing steel, and $45 per M.B.M. for lumber left in place.

(Editor's note. Mr. Tilley is to write an article describing the construction of a long dike at Shoal lake on this same project. This article will appear in an early number.)

THE EFFECT OF THE OREGON WATER CODE DECISION UPON CODES OF OTHER STATES.

By PERCY A. CUPPER†

For the purpose of considering the effect of the decision of the United States Supreme Court in the case of the Pacific Live Stock Co. *v.* Lewis *et al* upon the water codes of other States, these statutes may be divided into four classes, with reference to the determination of water rights:

First, those in which the entire procedure is before the courts, as in Colorado; second, those in which the procedure is before some special tribunal, with an appeal to the courts, as in Wyoming; third, those in which the procedure is before a special tribunal, but passed on by the courts, as in Oregon; and fourth, those in which provision is made for special surveys and investigations by the State engineer.

Regardless of the character of the determination, all the water-code States are interested in the jurisdictional point, in that a water-right determination is not transferable to the Federal courts on the ground of adverse citizenship. In practically all States having a special tribunal for the determination of water-rights the State courts have held that the tribunal is administrative in character, exercising quasi-judicial functions, and the Supreme Court of the United States accepts this interpretation and upholds the Oregon State courts on the ground that the findings of the Board are not final and conclusive, saying, "Even when no exceptions are presented, a decree giving effect to the order is to be entered; that is to say, that the matter is not left as if the order itself constituted an effective adjudication." Referring to the proceedings before the Board and before the Court, it was said: "They are not independent, or unrelated, but parts of a single statutory proceeding." "The Board merely paves the way for an adjudication by the courts of all the rights involved." It would seem, therefore, that notwithstanding the fact that the code was based upon the Wyoming statute, the adjudication of the Oregon code has not strengthened the Wyoming system. It is difficult to foretell how the Supreme Court would view the Wyoming and Nebraska statutes, under which the State courts have declared their special tribunals to be administrative although their findings are conclusive unless an appeal is taken. However, it is incredible that these well-established systems of water titles will ever be overthrown by judicial decree. The codes of all the States having special tribunals, and of some of the other States, as Idaho, for example, provide for surveys and investigations by the State, and the data obtained are now established as prima facie evidence. Only the special-tribunal States are interested in the enforcement of such a tribunal's findings, and doubtless the constitutionality of the Wyoming system will be established on this basis.

The Colorado system of adjudicating water rights by the courts, though involving the somewhat cumbersome prescribed court procedure, nevertheless possesses the redeeming virtue of being free from any question of constitutional infringement. While the Supreme Court decision did not affect the Colorado statute, it placed the Oregon code on the same basis in this particular without saddling upon the latter the objectionable features of the Colorado system.

*Extract from address delivered at the meeting of the International Irrigation Congress at El Paso, October 1916.

†Assistant State engineer, Salem, Oregon.

LIGHT-WEIGHT CARS FOR ELECTRIC RAILWAYS

An article by W. E. Moore in the *Electric Journal* discusses the use of one-man light-weight cars on electric railways. Jitney competition has shown the railway companies that on many of their lines they must provide a light car running on frequent headway and making a minimum of stops. These new cars are usually from 25 to 30 ft. and seat from 20 to 28 passengers. They are mounted on a single truck with a 9-ft. wheelbase. The weight is from 9000 to 10,000 lb. and the cost between $2500 and $3000. Under ordinary conditions, these cars require a maximum of 0.75 kilowatt-hours per car-mile, as against 1.75 to 2.5 kilowatt-hours for the ordinary single-truck two-man car, so the saving in power is usually $2 to $3 per day. The greatest saving is, of course, in the elimination of the conductor. New construction where such cars are employed is also considerably cheaper, since light rails may be used. The cost of these light cars can probably be still further reduced when their design has been standardized.

The production of casing-head gasoline in the United States during 1915 was 65,364,665 gallons, a gain of 22,712,033 gallons, or 53% over the production in 1914. The average recovery per 1000 cu. ft. of natural gas was 2.57 gallons. Nearly half the production, or 31,665,991 gallons, came from Oklahoma, while California was second with 12,835,126 gallons.

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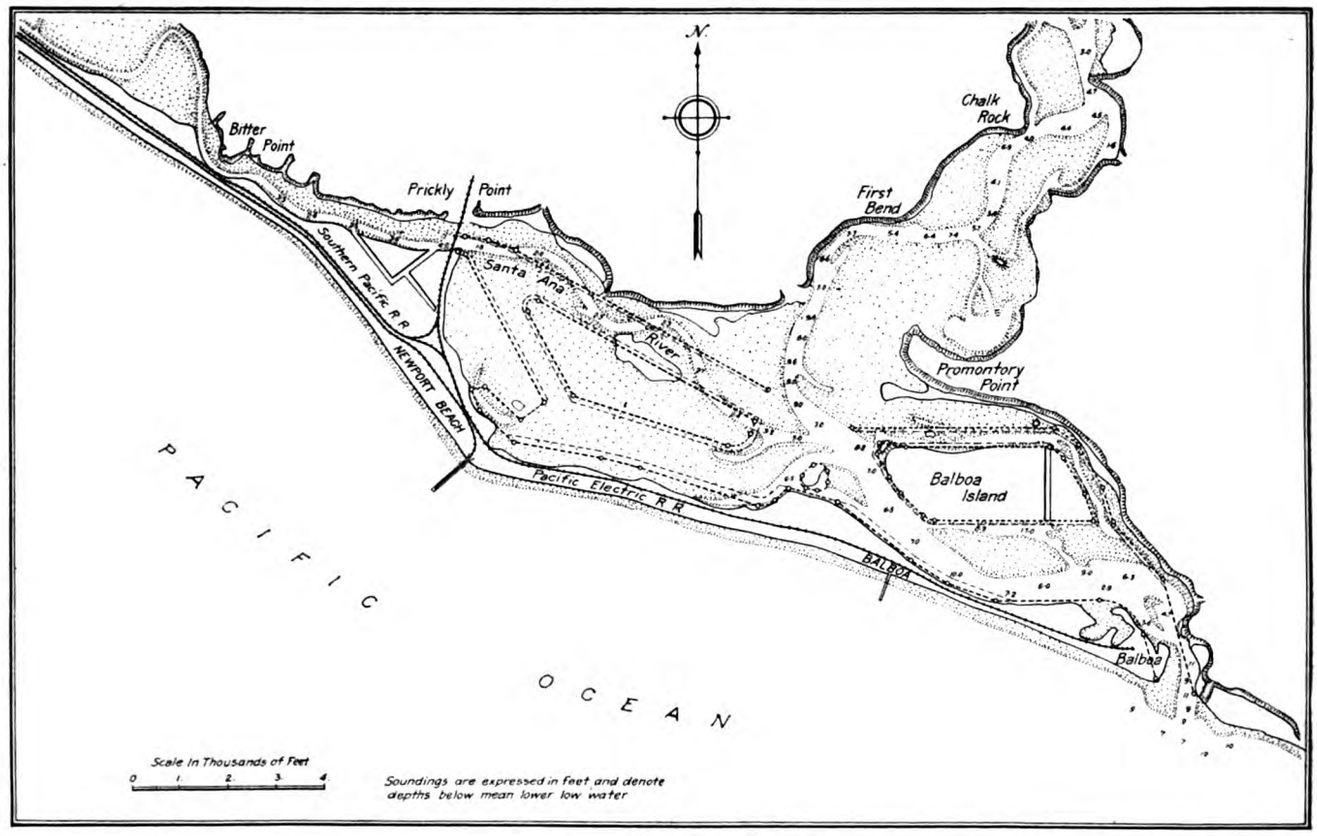
Proposed Harbor Improvements at Newport Beach, California

The city of Newport Beach is situated on a narrow peninsula bordering on Newport bay at the mouth of the Santa Ana river. For the improvement of the bay, which has now practically no commercial value as a harbor, the citizens, on September 25, voted a bond issue of $125,000. Of this amount, $100,000 is to be used for the construction of a jetty on the westerly side of the entrance to the bay, and $25,000 for dredging a channel from the entrance.

The jetty and channel work to take place under this bond issue is probably the first step toward the construction of a harbor at Newport bay of sufficient depth to accommodate most coastwise vessels. The Orange County Harbor Commission recently employed Charles T. Leeds of Los Angeles to report on the entire harbor question. An abstract of Mr. Leeds' report follows:

It is proposed to construct a harbor at Newport bay that will be adequate for the average coastwise lumber-vessels and also for barge traffic with Los Angeles harbor. The project outlined in the report to the War Department by Colonel C. H. McKinstry on March 3, 1913, provided for a depth of 10 ft. at mean low water, or approximately 15 ft. at high water. This is not sufficient, and it is recommended that a low-water channel-depth of 16 ft. be provided, with a depth of 20 ft. at the entrance, to allow ships drawing more than 16 ft. to await a favorable stage of the tide. There should also be a depth of 20 ft. at the wharf. The channel width at the entrance should be 300 ft. Inside the bay the width should be 150 ft. A turning basin at the wharf 400 ft. wide should be provided. A number of wash-borings have been made, which show that except for possibly a little rock at the entrance, the material is such that it can be handled readily with a suction dredge. It is probable that the entrance channel can be located so that even this small amount of rock can be avoided.

The prevailing littoral drift of sand has gradually pushed the mouth of Newport bay eastward until it has reached the rocky headlands of Corona Del Mar. Further eastward progress is therefore impossible and the present position of the bay entrance may be regarded as permanent. The tidal prism of the bay can maintain a depth of 4½ to 6 ft. at the entrance. To maintain a channel of greater dimensions it will be necessary to construct a jetty on the west side of the entrance. This jetty will also check the littoral drift of sand. By careful observation during and after the construction of this jetty, it will be possible to determine whether a second jetty on the east side of the entrance should be constructed, or whether it will be



MAP OF NEWPORT BAY AND HARBOR.

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cheaper to maintain the channel-depth by dredging. A wharf 600 ft. long and a warehouse should be constructed near the county bridge.

Silting of the harbor may be prevented by the construction of an earth dam across the Santa Ana river at Bitter point, and the construction of a direct outlet to the ocean for the river. The construction of this outlet is a necessary part of measures for effective flood-control on the river, and the cost, estimated at $64,000, should be borne by the several flood-protection districts, rather than by the harbor project.

The following estimate of cost is given:

Jetty	$120,000	Spur connections	3,000
Rip-rap	12,000	Dam	1,500
Dredging	376,500		
Wharf	42,000	Total	$560,000
Warehouse	5,000		

From this amount Mr. Leeds deducts $120,000 as the assumed amount that the city of Newport Beach will spend directly. This leaves $440,000, to which he adds 15% for engineering and contingencies, giving a total of $506,000, as directly chargeable to the general harbor project. The construction of the jetty is undertaken by Newport Beach in order to increase its attractions as a pleasure resort, and the expenditure will be made regardless of the ultimate decision on the harbor project. It is estimated that the cost of maintaining the harbor after construction will not exceed $5000 per year.

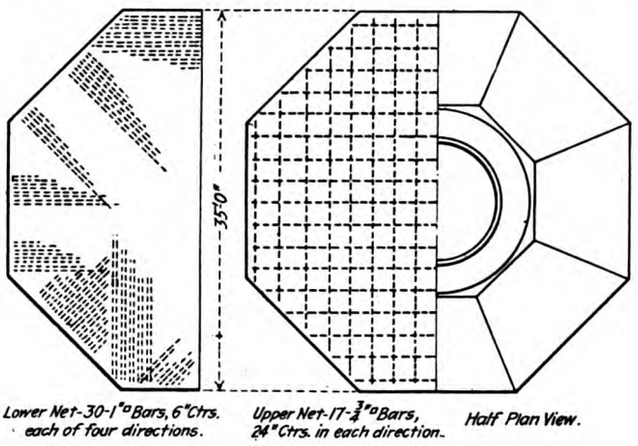
The members of the County Harbor Commission believe that the whole project can be carried out for less than the above estimate. The estimate for the jetty is based on obtaining rock from Corona at a cost of $1.25 per ton, but if the project is undertaken in the immediate future, rock may be obtained from the quarries on Catalina island operated by the city of Los Angeles. This rock will cost $0.88 per ton. It is also believed that the net cost of dredging can be considerably reduced through the sale of the dredged material for filling low lands.

The total length of public highways in the United States outside of incorporated towns and cities is 2,452,000 miles, according to statistics compiled by the Office of Public Roads and Rural Engineering of the Department of Agriculture. About 277,000 miles, or 11.3%, has been improved with some form of surfacing. The surfaced highways have been increasing at the rate of about 16,000 miles per year. In 1915, about one-half of this increase was made under the supervision of State highway departments. Expenditures for highways and highway bridges have increased from $80,000,000 in 1904 to $282,000,000 in 1915. The proportion expended by State highway departments increased from $2,550,000 to $53,000,000 during the same period. In addition, $27,000,000 of local funds was expended under State supervision of State highway departments, making a total of $80,000,000 in all, or as much as the total expenditure for highway work in 1904. There are now State highway departments in every State except Indiana, South Carolina, and Texas.

METHODS OF CONSTRUCTION OF 200-FT. REINFORCED CONCRETE CHIMNEY AT AGNEW, CALIFORNIA*

The waste molasses from the various sugar refineries in California and also from several refineries in the Hawaiian Islands, is shipped to the plant of the Western Grain & Sugar Products Co. at Agnew, about five miles from San Jose. At Agnew, the molasses is fermented and the alcohol distilled from it. The refuse is then heated until the moisture is driven off, and it is finally carbonized in furnaces similar to those used in the open-hearth steel process. When the plant was constructed in February of this year, large blowers and exhaust fans were used to obtain the required draft, but, as this was not entirely satisfactory, a 200-ft. reinforced concrete chimney has recently been constructed to take the place of the blowers and fans.

The site of the chimney is near the Guadalupe river, and the soil is a fine quicksand, which extends to a depth of 40 ft. One hundred and fourteen piles were



PLAN OF BASE OF CHIMNEY.

driven to hard bottom for the foundation. The dimensions and design of the chimney are shown in the drawings. The original plans were revised by Charles Derleth, Professor of Civil Engineering at the University of California. Particular attention was paid to possible earthquake stresses and the amount of steel was increased considerably over that provided at first. The total amount used was 26 tons.

A mixture of one part of cement, three of sand, and six of gravel was used for the foundation, and one of cement, three of sand, and three of crushed rock for the superstructure. Sheet-steel forms were used, cut to the proper taper. The outside forms were 7 ft. 9 in. high and were adjusted by screws attached to a ring in such a manner as to make the sheet-steel conform to a perfect circle. Each time the form was raised, an additional amount of lap was taken in the sheets to give the required reduction in diameter. The inside forms were in two sections, each 3 ft. 9 in. high.

*From data furnished by W. A. Wood, Box 388, Route A, San Jose, California.

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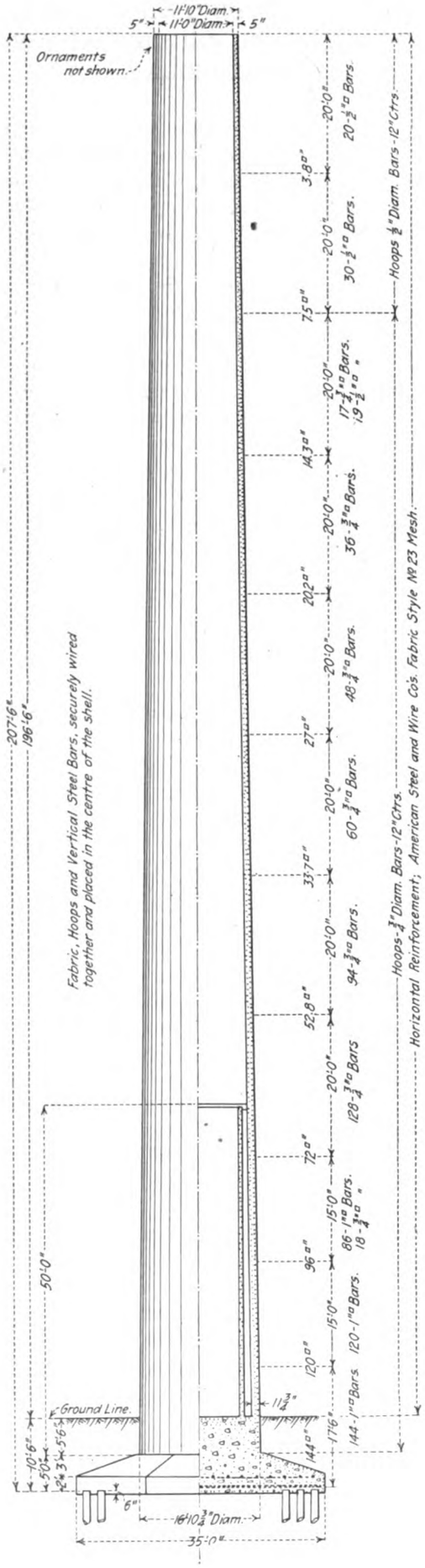

Their relative positions one above the other were alternated with the progress of the work. The regular rule was to pour one 7 ft. 6 in. section per day.

The inside of the stack was filled solid with concrete up to zero or ground elevation. From this point it was lined with one course of hard red brick laid in a mortar composed of silicate of soda and fine sand and was whitewashed with silicate of soda. This was done to protect the concrete from acids. For the same reason, the outside of the stack from the top downward for a distance of 50 ft. was whitewashed with silicate of soda. For the remainder of the outside of the stack a mixture of cement and hydrated lime was used.

The total amount of cement used was 2650 sacks. The cost of the chimney complete was about $12,000. The work was done for the Western Grain & Sugar Products Co. by the Concrete Construction Co. of Chicago.

HOW TO STORE CEMENT

It is sometimes thought that only one thing is necessary for the safe and effective storage of cement, a tight roof. Many years' experience has convinced me that water-tight storage is not enough, and I have formulated the following principles for cement storage:

1. Cement will retain its strength for an indefinite period when stored in air-tight containers.
2. Cement will be injured less by storing in paper sacks than in cloth sacks, everything else being equal.
3. Stored cement in any kind of commercial packages will be injured least if the packages are piled as close together as possible. In other words, the outside surface of the pile of sacks should be a minimum.
4. Piles of cement sacks should be covered with a tarpaulin to prevent as far as possible the circulation of air through the pile.

Note the word 'tarpaulin'; an ordinary canvas cover is not a tarpaulin, but a paulin. Five parts coal tar, one part gasoline, and one part good japan drier make a water-tight black coating for canvas.

Surface condensation often takes place on a stored sack of cement. The moisture is carried into the cement to its great injury as well as the practical destruction of the sack. The condition of the sack may not be evident at once; in fact, may be returned to the mill, re-filled, and sent to some other job, where it bursts and is paid for by someone who was in no way responsible for its condition.

There is a saying among cement men that if you turn your cement, that is, move it from one pile to another, once a month, it will not be injured by an indefinite period of storage. This is not the case; pile it closely and give it a covering as nearly air-tight as possible and you will have little caked cement. If the cement is caked, it is better to let it alone until you are ready to use it, rather than break the cake, thus presenting fresh cement to the action of the air.—S. P. Baird in *Cement and Engineering News.*

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Engineers' Note Book

CHART FOR CORRECTING STEEL TAPES FOR SAG, STRETCH AND TEMPERATURE*

By WALTER SCOTT WEEKS

The accompanying chart may be used for determining the total correction for sag, stretch, and temperature on any slope for a given tape, given a pull of 2000 times the weight of 1 ft. of tape, and provided that the temperature at which the tape is standard is known. The following example illustrates the method:

A tape whose standard temperature is 32° F. is used when the temperature is 62° F., the angle of inclination is 60% and the length in use is 160 feet.

The temperature is 30° higher than the standard. Place one point of a pair of dividers on the intersection of the temperature line marked + 30 and the vertical 'feet' line marked 160. Place the other end of the dividers on the intersection of the sag curve marked 60° and the vertical 'feet' line marked 160. Transfer this distance to the vertical scale at the left where the correction is read. It is seen to be 0.057.

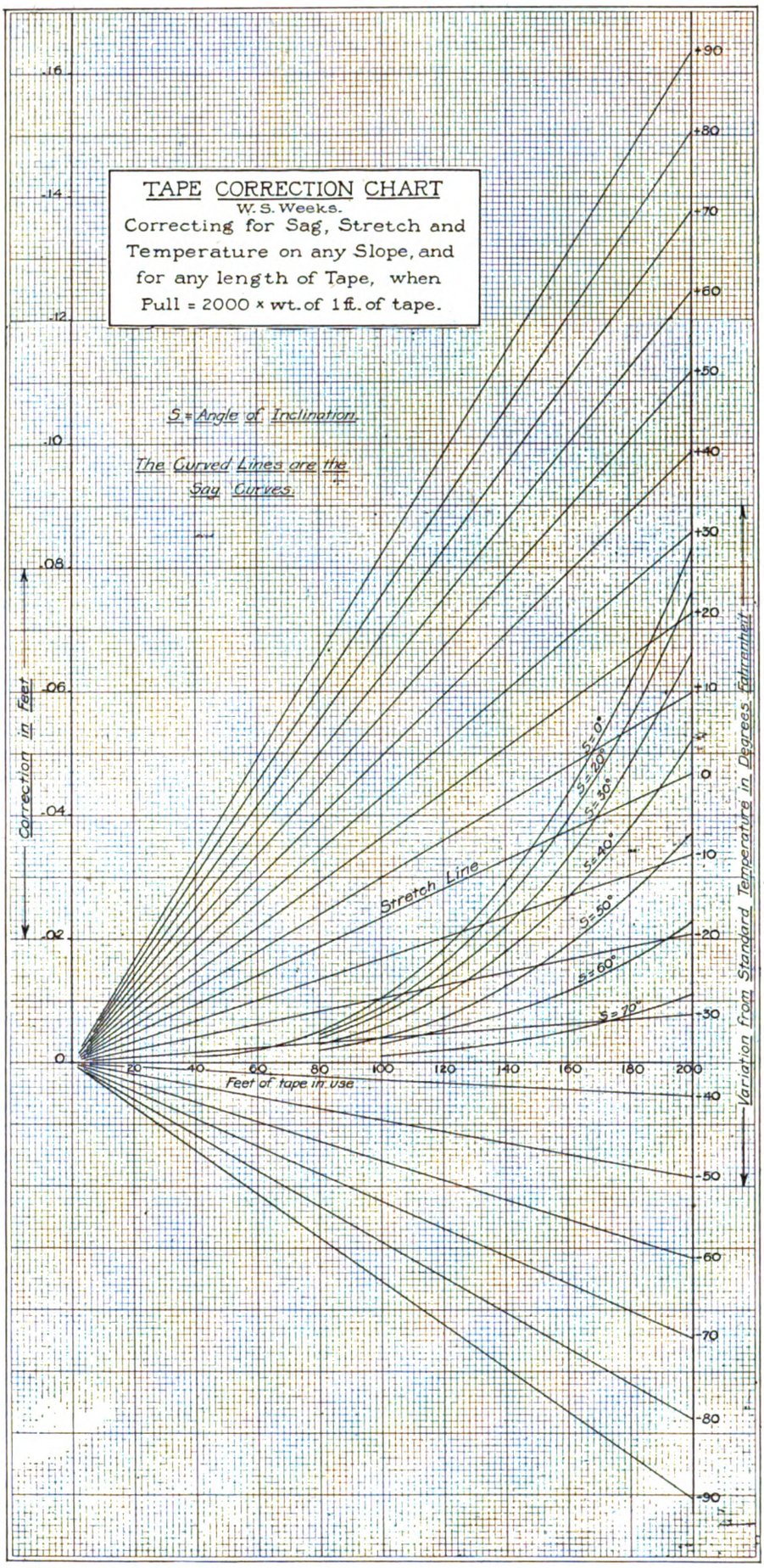
If the temperature line is above the sag line, the correction must be added. If the sag line is above the temperature line, the correction must be subtracted. This results from the fact that when the tape is too long the recorded distance is too small and when the tape is too short the recorded distance is too large.

In the present instance, 0.057 must be added.

It should be remembered, of course, that the corrected distance will be the slope distance and that the horizontal distance is still to be computed by multiplying the slope distance by the cosine of the included angle. For the average engineer's tape, measuring 0.02 in. thick and 0.125 in. wide, the required pull of 2000 times the weight of 1 ft. of tape would be approximately 17 lb. More exact figures could be obtained by weighing the tape.

For obtaining the exact pull, a spring-balance such as balance No. 633 manufactured by the Chatillon Co. is recommended. An adjustable stop may be arranged so that it may be set at the working-pull for any particular tape.

*Abstracted from University of California publications in engineering.



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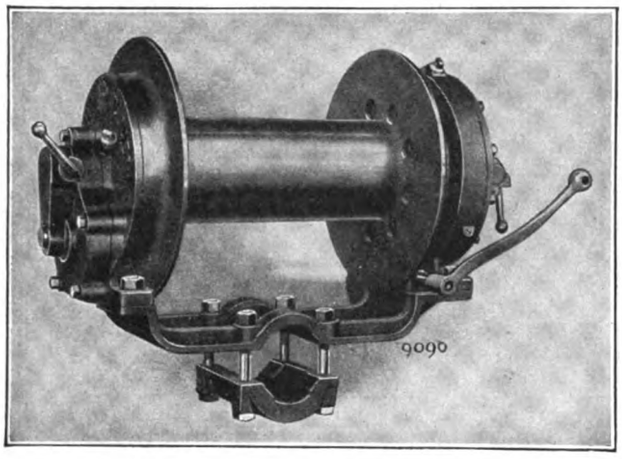
Industrial Progress

A NEW MODEL LITTLE TUGGER HOIST

For the use of those who prefer manila rope to wire rope for light hoisting and hauling, the Ingersoll-Rand Company of New York has devised a new model 'Little Tugger' hoist which is designated No. 11.

The square piston, reversible driving engine, automatic lubrication, enclosed gearing, drum-release clutch, and worm-



THE NEW LITTLE TUGGER HOIST.

operated hand-brake are essentially the same as in the well-known No. 1 model. The main differences are in the diameter and length of drum, the width of the flanges and, necessarily, the main frame and overall dimensions. The new No. 11 has a hoisting drum 7 in. diam. by 17 in. long, with 5-in. flanges. This accommodates 300 ft. of $\frac{7}{8}$-in. manila rope. The maximum capacity of this hoist is conservatively rated at 600 lb. The weight of the hoist itself is 358 lb. It is 21½ in. long, 31¼ in. wide, and 23 in. high. Like the No. 1, the No. 11 machine is designed for operation both by compressed air and steam. The standard clamp fits a 4½ in. diam. column or pipe, but by removing the clamp the hoist can be readily bolted directly to any convenient support, timber, or flooring.

Although designed primarily for underground work, it is recommended by the manufacturer for general hoisting, hauling, and handling in mines, tunnels, quarries, and industrial plants.

Book Reviews

PRINCIPLES OF OIL AND GAS PRODUCTION. By Roswell H. Johnson and L. G. Huntley. P. 371. Ill., index. John Wiley & Sons, Inc., New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $3.75.

The authors' aim in preparing the book, as expressed in the opening statement, "to fill the need for a general treatise on the production of oil and gas, since the books on the subject are too brief, out of date, inapplicable to American conditions, or treat only a small part of the field," cannot be and has not been attained in a book of only 370 pages. The main value of the book is in the compilation of literature relating to the geologic features of the North American oilfields, a discussion that comprises about one-third of the volume. The editing of the voluminous literature on the subject has been done judiciously and only here and there, as in the account of the California oilfields, where it is stated that the oil pools extend to the Mexican border, are minor misstatements made. The value of this part of the work would have been greatly enhanced had more foot-notes been given or authorities for the many quoted statements. In this connection it seems as if somewhere in the book the authors should have had occasion to mention the works of Engler and Boverton Redwood, which continue to be the most comprehensive on the broad subject in question. Geologists will be interested in the authors' views on the effect of the altitude and character of the beds on the migration, accumulation, and recovery of oil and gas. These views together with an interesting discussion of mooted geological questions take up about one-third of the book. As only about one-fourth of the book is devoted to subjects of direct interest to the average oil operator, the work as a whole may be said to be primarily of interest to the geologist, who will find in it a great deal of valuable information in a condensed form.

STEAM POWER. By C. F. Hirshfeld and T. C. Ulbricht. Third edition. P. 420. Ill., index. John Wiley & Sons, New York, 1916. For sale by the *Mining and Scientific Press*, San Francisco. Price, $2.

While essentially an elementary work on the steam engine and accessories, for colleges and technical schools, power-plant engineers will find it of value on many points. The matter is up to date, including as it does notes on the latest boilers, stokers, and turbines. The physical conceptions and units, and discussion on steam are well given. Various types of engines are described. Combustion is explained in a practical manner, also recovery of waste heat. The illustrations have been well selected. Altogether, the book will be found worth the price.

STRESSES IN STRUCTURES. By A. H. Heller. Revised by C. T. Morris. P. 358. Ill., index. John Wiley & Sons, Inc., New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $2.75.

The purpose of this volume, it is stated in the preface, is to furnish a text-book for the student and a reference book for the practising engineer, rather than an exhaustive treatise on the subject, and this purpose appears to have been well accomplished. The first two chapters deal with stresses of all kinds, both above and below the elastic limit. The computation of stresses is then considered, by both the analytic and the graphic methods. Stresses in the different types of simple and continuous beams are then discussed, and then stresses in roof trusses and in railway and highway-bridge trusses. A number of practical problems are given at the end of each chapter.

COAL MINERS' POCKET-BOOK. P. 1172. Ill., index. McGraw-Hill Book Co., New York, 1916. For sale by the *Mining and Scientific Press*, San Francisco. Price, $4.

This is the 11th edition, revised and enlarged, of what was formerly the 'Coal and Metal Miners' Pocket-Book.' In this edition matter dealing with mining of ore has been omitted, hence the change of title. But those connected with any class of underground work will find here a fund of information, such as mathematics, surveying, concreting, wire ropes, properties of materials, hydraulics, value of fuels, boilers, compressed air, electricity, explosives, timbering, haulage and hoisting, ventilation, and glossary of mining terms. The book is well arranged, printed on thin paper, is flexible, and should be found worth the price.

THE AMERICAN PETROLEUM INDUSTRY. By R. F. Bacon and W. A. Hamor, with special chapters by F. G. Clapp, Roswell H. Johnson, J. P. Cappeau, and L. G. Huntley. In two volumes. P. 923. Ill., index. McGraw-Hill Book Co., Inc., New York. For sale by the *Mining and Scientific Press*, San Francisco. Price, $10.

This treatise is probably the most exhaustive that has been

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published on the subject of American petroleum. Volume I is concerned mainly with production. The first chapter gives a summary of the various theories of the origin of petroleum, without attempting to decide between them. Succeeding chapters deal with geology, distribution, and physical and chemical properties of petroleum. Next comes an historical sketch of the petroleum industry in the United States. The chapter on oil-well technology discusses the various methods of drilling, torpedoing, and cementing oil-wells. Other chapters discuss valuation of oil property, the decline of production of wells, and efficiency in production. The concluding chapter in Volume I deals with the condensation of gasoline from natural gas.

Volume II is mainly devoted to the refining side of the industry. Refinery technology is discussed in two chapters, both as regards Eastern and Californian oils. The latest developments in refining, including the Rittman and Burton processes are discussed. Another chapter deals with refinery construction and includes the complete specifications for a large refinery recently constructed in Pennsylvania. The effect of their occupation upon the health of oil-workers is considered. Some of the problems, unsolved or only partly solved are outlined briefly. The closing chapter is devoted to the shale-oil industry, and is necessarily based mainly upon Scotch practice. There is a complete glossary of oilfield and refinery terms, including many foreign words. The treatise will be found invaluable by those interested in the petroleum industry.

CONTRACTS, SPECIFICATIONS, AND ENGINEERING RELATIONS. By Daniel W. Mead. P. 518. Ill., index. McGraw-Hill Book Co., New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $3.

The divisions of this book that treat of contracts and specifications are similar in character to several other treatises on these subjects that have appeared during the past few years, although the treatment is perhaps more complete in the present volume. The division dealing with engineering relations, which includes presumably the chapters on The Engineer and His Education; Success in the Engineering Profession; The Engineer at Work; Personal and Ethical Relations; The Use of English; Letters and Reports; Origin, Nature, and Development of Law; Some Legal Relations of Technical Men; and Legal Rights and Responsibilities, is largely devoted to matters that have never been discussed so thoroughly before. It is also true that discussion of a number of subjects that is usually found scattered among a number of volumes is here grouped so that the relation between them is clearly shown. It has frequently been pointed out that the work of the true engineer deals with men as much as with materials and machines. We know of no book better suited to guide the young engineer in his relations with men than the present volume. However, the book is of value to the experienced member of the profession as well as to the student and young engineer. The older engineer will probably find a good deal that he did not know before, besides being able to use the volume as a reference book to make sure that he has omitted nothing in the preparation of an important set of specifications.

Following the chapters already mentioned, there are several that comprise a brief but complete discussion of the law of contracts as applied to engineering and construction matters, not befogged by unnecessary legal terms. The sections dealing with specifications discuss the general principles underlying specification writing and then proceed to the consideration of specifications for particular kinds of work and materials. Here also the emphasis is laid upon the objects to be attained by each clause in the specifications, rather than upon the wording of particular sections. In fact, special attention is paid to the danger of copying specifications used on some other work without making sure that each clause is applicable to the work in hand. There are four appendices. The first contains outlines of specifications for several different kinds of construction. The second contains a sample contract and specifications for a complete structure, in this case, a concrete reservoir and suction-well. The third contains a number of examples of drawings that may be used in connection with specification writing. The fourth is a classified bibliography, whose completeness may be judged from the fact that it comprises 50 pages.

CONSTRUCTION OF THE LOS ANGELES AQUEDUCT. P. 319. Ill., index, with 23 plates in pocket. The Department of Public Service, Los Angeles. Price, $1.95.

This is a combined real-estate circular and engineering monograph, in which, unfortunately, the real-estate circular *motif* seems to predominate. In fact, with the exception of a report on the water resources of Owens valley, printed in an appendix, there is no external and little internal evidence that any engineer took part in its composition. Nor are the mechanical features of the volume much better. There are several instances of poorly-executed drawings, slipshod grammar, and errors in spelling. Perhaps the most flagrant of the latter is the misspelling of the name of a former city engineer of Los Angeles three times on one page. Such blunders may, perhaps, be pardoned in a progress report, but are inexcusable in a book appearing nearly three years after the completion of the project. The photographs, which are largely of the real-estate circular class, are, however, excellent.

Several chapters at the beginning of the book are devoted to historical matters and a general description of the aqueduct project, including the now famous tufa-cement plants. Then comes a description of the different structures, with which is included some cost-data. The remaining chapters are concerned mainly with accounting and financial matters. There are two appendixes, one dealing with the water resources of Owens valley, and the other reviewing the discussion and subsequent lawsuits regarding the sanitary qualities of the aqueduct. In general, it might be stated that the engineer who wishes to take the time, can glean several grains of wheat from the large amount of chaff contained in the report.

MUNICIPAL ENGINEERING PRACTICE. By A. Prescott Folwell. P. 407. Ill., index. John Wiley & Sons, Inc. For sale by *Mining and Scientific Press*, San Francisco. Price, $3.50.

Municipal engineering includes a large number of loosely related subjects, some of which, such as water-supply, street paving, and sewers and sewage-disposal are discussed in a number of books. Others, which, while of somewhat smaller importance, are nevertheless of great interest to the city engineer, are treated lightly or not at all in the published treatises. It is mainly to discuss these hitherto neglected topics that the present volume has been written. The first chapter on fundamental data is mainly concerned with population densities and estimates of future growth. Succeeding chapters discuss the city plan, street surface details, including sidewalks, curbs, and gutters, and street railways, city surveying, bridges and waterways, street lights, signs, numbers, and street cleaning and sprinkling. The chapter on the disposal of city wastes treats mainly of garbage disposal, and does not attempt to consider sewage. The two closing chapters are devoted to markets, comfort stations, and baths, and to parks, cemeteries, and shade-trees. The book is well illustrated and should be of value to city officials.

LABORATORY MANUAL OF BITUMINOUS MATERIALS. By Prevost Hubbard. P. 153. Ill. John Wiley & Sons, Inc., New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $1.50.

The title of the book states that it is for the use of students in highway engineering. This doubtless includes the many engineers now engaged in highway construction who completed their technical training before highway engineering became

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recognized as a special subject, and who, as well as the college student, will find the present volume of value. Part I gives a general discussion of bituminous materials. Part II describes in detail the various tests and the different methods used for making these tests. Part III gives the characteristics of the more important bituminous materials. A number of blank pages for notes are included with the text.

TREATISE ON HYDRAULICS. By Mansfield Merriman. Tenth edition. P. 556. Ill., index. John Wiley & Sons, Inc., New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $4.

In the latest edition of this standard work, a considerable part has been revised or re-written and considerable new matter added. The more important additions include a complete table of values for *n* in Kutter's formula, based upon Horton's recent experiments and a discussion of the newer types of hydraulic turbines. The chapter headings are Fundamental Data, Hydrostatics, Theoretical Hydraulics, Instruments and Observations, Flow through Orifices, over Weirs, through Tubes, through Pipes, in Conduits, Flow of Rivers, Water Supply and Water Power, Dynamic Pressure of Water, Water-Wheels, Turbines, Naval Hydromechanics, and Pumps and Pumping. The hydraulic tables are placed in the text next to the explanation of their use, but a special index of the tables facilitates reference.

New Publications

FACTS ABOUT WATER-POWER. The Water-Power Development Association, Munsey Bdg., Washington, D. C. The main purpose of this pamphlet is to further the passage of more liberal legislation regarding the development of water-power at sites requiring Federal permits, and particularly to controvert some of the arguments of the 'Merrill' report regarding the danger of a water-power monopoly. It is shown that less than 10% of the 60,000,000 hp. of available water-power in the country is developed. Of this amount 46,000,000 hp. is at sites requiring Federal permits, of which only 4% has been developed, while 25% of the 14,000,000 hp. available at private sites has been developed, indicating that the former kind of development has been retarded by the present laws. It is also shown that the ownership of the developed water-power is not monopolized.

MINERAL PRODUCTION OF CALIFORNIA. Bulletin No. 71, California State Mining Bureau, Ferry Bdg., San Francisco. P. 170. Ill., index. Contains a detailed report on the mineral production of California, by substances and by counties. The total production for the year was valued at $96,663,369 including 49 substances, obtained from 56 of the 58 counties of the State. An appendix contains the fundamental Federal and California statutes relating to oil and mining operations, also a set of county maps on scales varying from 18 to 30 miles to the inch, and showing post-offices, railroads, and main highways.

GRAPHICAL SOLUTIONS OF ELECTRIC RAILWAY PROBLEMS. By A. M. Buck. Bulletin No. 90, of the Engineering Experiment Station, University of Illinois, Urbana, Ill. Gives diagrams showing the relation between motor-current and speed, current and tractive effort, speed and tractive effort, and speed and time.

POSSIBLE SOURCES OF WATER SUPPLY FOR CITY OF SACRAMENTO, CALIFORNIA. By Charles Gilman Hyde, George H. Wilhelm, and Frank C. Miller. P. 624. Ill., index, also a number of diagrams and tables on inset sheets. Published by the city of Sacramento, California.

MEASUREMENT OF SILT-LADEN STREAMS. By R. C. Pierce. Bulletin 400-C, U. S. Geological Survey, Washington, D. C. Devoted mainly to methods of measurement of the San Juan river in Utah, which frequently carries large amounts of silt.

Civil Service Examinations

MARINE ENGINE AND BOILER DRAFTSMAN. Certification will be made to fill approximately fifty vacancies in this position in the Bureau of Steam Engineering, Navy Department, Washington, D. C., and at the Navy Yards at New York, N. Y., and Mare Island, Cal., at salaries ranging from $3.28 to $7.04 per diem.

This examination is held especially to secure eligibles having technical training and experience in the design and construction of marine engines and boilers. It is also desired to secure persons with training and experience in the design of submarine, turbine, gasoline, and aeroplane machinery. As the supply of eligibles resulting from recent examinations for marine engine and boiler draftsmen has not been equal to the demand, qualified persons are urged to enter this examination.

Competitors will not be assembled for examination, but will be rated on the following subjects, which will have the relative weights indicated:

Subjects	Weights
1. Physical ability	10
2. Education, training, and experience	90
Total	100

Applicants must be graduates of or senior students in a technical school or college of recognized standing, or have had at least three years' experience in marine engineering or allied work, of which at least two years must have been spent in the drafting room. Persons with only the minimum qualifications will be appointed at the minimum salary; appointments will not be made at a higher compensation except of those eligibles who show considerably more experience than that set forth as the minimum qualification. Statements as to education, training, and experience are accepted subject to verification.

Until further notice and on account of the urgent needs of the service, applications will be received at any time and the papers will be rated immediately upon their receipt, in order that appointments may be made with the least possible delay.

Age, 18 years or over on the date of filing the application. Applicants will be admitted to this examination regardless of their residence and domicile; but under an act of Congress only those who have been actually domiciled in the State or Territory in which they reside for at least one year previous to the date of the examination will be eligible for appointment to a position in the apportioned service in Washington, D. C. Persons desiring to become eligible for appointment in the apportioned service must have the county officer's certificate in the application form executed, to which a 10-cent internal-revenue stamp must be attached.

Application Form 1312 should be properly executed and filed with the Commission at Washington as soon as possible.

DESIGNING ENGINEER. Four vacancies at salaries ranging from $10 to $15 per diem in the Bureau of Yards and Docks, Navy Department, Washington, D. C. The duties of the position embrace the design and supervision of design of large and various engineering works in steel, concrete, reinforced concrete, etc., for the navy yards and naval stations.

Competitors will not be required to report for examination at any place, but will be rated on the following subjects, which will have the relative weights indicated:

Subjects	Weights
1. Technical education	30
2. Experience and fitness	70
Total	100

Graduation with a degree in engineering from a college or university of recognized standing, with subsequent experience

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of not less than 15 years on general design work, of which not less than five years must have been in responsible charge in the successful designing of works of importance and magnitude, such as structural steel shops and storehouses, reinforced-concrete structures, retaining walls, and deep foundations, tunnels or subways, waterfront work, such as quay walls, piers, wharves or dry docks, etc., are prerequisites for consideration for this position.

In view of the early date of examination demanded by the urgency of making appointments as soon as possible, it is necessary that persons desiring to be considered should secure the necessary form at once and mail it, properly executed, to the Commission without delay.

Applicants must not have reached their fifty-fifth birthday on the date of the examination. Application form 1312 should be filed with the Commission at Washington, D. C., by December 11.

PETROLEUM ACCOUNTANT. Bureau of Mines, Department of the Interior, for service in the field, at salaries ranging from $1800 to $2500 a year. The duties of this position will be to investigate the systems of accounting and costs in various branches of the petroleum industry.

Competitors will not be required to report for examination at any place, but will be rated on the following subjects, which will have the relative weights indicated:

Subjects	Weights
1. Education	30
2. Experience	40
3. Thesis	30
Total	100

Graduation from a high school of recognized standing and at least two years' experience in charge of accounting, including cost accounting, covering drilling for and producing of oil and gas, and the manufacture of gasoline from natural gas, are prerequisites for consideration for this position. Special credit will be given for experience in connection with refineries. Under subject 3 the thesis should be a discussion of cost accounting, with special reference to the petroleum industry.

Applicants must have reached their twenty-first but not their fortieth birthday on the date of the examination.

Application Form 2118 must be filed with the Commission at Washington by December 26.

LABORATORIAN, QUALIFIED IN STRENGTH OF MATERIALS. January 3. Laboratorian, at $3.04 per diem, in the Navy Yard, New York, N. Y. The duties of the position cover the making of physical tests of miscellaneous materials, experimental tests on miscellaneous materials, principally iron and steel alloys, and fittings, and research work in connection with the revision of standard specifications. The appointee should understand the operation of testing machines for making tensile and compressive tests of metals, etc.

Competitors will be examined in the following subjects, which will have the relative weights indicated:

Subjects	Weights
1. Theoretical and practical questions in physics, mechanics, and strength of materials	60
2. Training and experience	40
Total	100

Applicants must show graduation from a four years' high-school course, or four full years of study in a school offering a course equivalent to that of a high school, and must show specifically that their course comprised at least one year of elementary physics and mechanics, and in addition at least one year of laboratory experience involving a knowledge of the strength of materials, which may have been gained in the testing department of manufacturing concerns or in the laboratory of a technical school.

Applicants must have reached their twentieth birthday on the date of the examination. Applicants may be examined at any place at which this examination is held, regardless of their place of residence; but under an act of Congress only those who are examined in the State or Territory in which they reside and who have been actually domiciled in such State or Territory for at least one year previous to the examination will be eligible for appointment to a position in the apportioned service in Washington, D. C. Persons desiring to become eligible for appointment to the apportioned service must have the county officer's certificate in the application form executed. Applicants must submit to the examiner on the day of the examination their photographs, taken within two years, securely pasted in the space provided on the admission cards sent them after their applications are filed. Tintypes or proofs will not be accepted.

Application Form 1312 should be filed with the Commission at Washington in time to arrange for the examination at the place selected by the applicant.

Engineering Societies

IDAHO SOCIETY OF ENGINEERS. Ira F. Schaffner, secretary, Boise.

Los Angeles Section of AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Ford W. Harris, secretary, 1029 Higgins building.

Los Angeles Section of AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Edward Woodbury, secretary, 255 East 3rd street.

OREGON SOCIETY OF ENGINEERS. Orrin E. Stanley, secretary, room 409, City Hall, Portland.

Portland Section, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Paul Lebenbaum, secretary, 45 Union Depot.

Portland Association of Members of AMERICAN SOCIETY OF CIVIL ENGINEERS. Charles McGonigle, president, care Western Sheet Metal Works.

San Francisco Association of Members of AMERICAN SOCIETY OF CIVIL ENGINEERS. E. T. Thurston, Jr., secretary, Mechanics Institute building.

San Francisco Section of AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Carl F. Braun, secretary, Hooker & Lent building.

San Francisco Section of AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. A. G. Jones, secretary, 811 Rialto building.

Southern California Association of Members of AMERICAN SOCIETY OF CIVIL ENGINEERS. W. K. Barnard, secretary, 701 Central building, Los Angeles.

UTAH SOCIETY OF ENGINEERS. Hugh C. Lewis, secretary, Capitol building, Salt Lake City, Utah.

Coming Conventions

AMERICAN ROAD BUILDERS' ASSOCIATION. Annual convention, Boston, Mass., February 5-9, 1917. E. L. Powers, secretary, 150 Nassau street, New York. The National Good Roads Show of Materials and Machinery will be held in connection with this convention.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS. Annual meeting. Chicago, Illinois. D. K. Shedd, secretary, Ames, Iowa.

MID-WEST CEMENT USER'S ASSOCIATION. Annual convention. Omaha, Neb., March 6-10, 1917. Frank Whipperman, secretary, 28th avenue and Sahler street, Omaha.

NATIONAL BUILDERS' SUPPLY ASSOCIATION, Chicago, February 12-13. L. F. Desmond, secretary, 1211 Chamber of Commerce, Chicago, Illinois.

NORTHWESTERN ROAD CONGRESS, Chicago, December 8-9. J. L. Long, secretary, Moline, Illinois.

PAVING BRICK INSTITUTE, Cleveland, Ohio, December 5-6. H. M. Macdonald, assistant secretary, Brotherhood of Locomotive Engineers Bdg., Cleveland.

PORTLAND CEMENT ASSOCIATION. Annual meeting. New York

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city, December 11-13. A. H. Ogle, assistant to general manager, Chicago, Illinois.

TENTH ANNUAL CEMENT SHOW, Chicago, February 7-15, 1917.

Personal

S. R. OLDAKER has been appointed city engineer of Hermiston, Oregon.

CHARLES EVAN FOWLER has been in San Francisco on professional business.

MILTON MAGGINI, formerly city engineer of San Jose, has resigned. He has been succeeded by WALTER HUNT.

J. L. LEE has been appointed valuation engineer for the Sierra Railway Co., with headquarters at Jamestown, California.

GEORGE W. CORRIGAN, formerly roadmaster for the Southern Pacific Co., at Hornbrook, has been appointed division engineer with headquarters at Stockton, California.

JAMES REED, naval constructor at the Mare Island Navy Yard, has been appointed superintending constructor of Government work at the Union Iron Works at San Francisco.

DOUGLAS JONES, formerly state electrical engineer for California, has resigned. He will engage in business for himself in Sacramento, handling tractors and other farm machinery.

J. A. KITTS, who has been in Plumas county for several months superintending the construction of a five-mile tramway for transporting lumber, has returned to San Francisco.

LIEUTENANT-COLONEL CHARLES L. POTTER, who has been in charge of the U. S. Engineer Office at Portland, Oregon, for the past few years, has been assigned to duty at Boston, Massachusetts.

W. S. CURTIS, of San Francisco, has been appointed assistant state engineer from a list of three eligibles certified as a result of a recent examination by the California State Civil Service Commission.

SIMON BAMBERGER, builder and principal owner of the Salt Lake & Ogden Railroad, has been elected governor of Utah. He is also noted as being the first Democrat and first non-Mormon to hold that position.

J. R. SHERMAN, formerly assistant engineer for the U. S. Reclamation Service, with headquarters at Meadow Creek, Washington, has resigned to become engineer for the Braden Copper Co., near Rancagua, Chile.

H. H. HENDERSON, formerly engineer for the Anderson-Cottonwood irrigation district, has resigned. The directors of the district have arranged for THOMAS H. MEANS to act as consulting engineer, and E. R. DAVIS as supervising engineer.

FREDERICK W. GAY has been appointed engineer for the Bankers Trust Co. of New York, trustee of the underlying mortgage of the Mount Whitney & Electric Co. He is now preparing a report upon the property of the Hanford Electric Co., the sale of which to the Mount Whitney company is proposed.

CHARLES P. WEEKS and W. P. DAY have opened offices for the practice of architecture and engineering at 933 Phelan Bdg., San Francisco. Mr. Weeks will have charge of the architectural department, and Mr. Day will have charge of engineering design and construction, succeeding the firm of Leonard & Day.

C. E. PARIS, for the past ten years superintendent for the Holton Power Co., Holton Interurban Railway Co., Imperial Valley Gas Co., Coachella Valley Ice & Electric Co., has resigned to become manager for the Imperial irrigation district. R. P. MOORE, formerly assistant superintendent, has been appointed superintendent for the Holton Power Co. and Holton Interurban Railway Company.

The following officers have been elected by the American Road Builders' Association: president, ARTHUR W. DEAN; vice-presidents, WILLIAM H. CONNELL, AUSTIN B. FLETCHER, and ARTHUR H. BLANCHARD; secretary, E. L. POWERS; treasurer, W. W. CROSBY; directors for three years, T. R. AGG, W. E. ATKINSON, FRED E. ELLIS, R. H. GILLESPIE, B. MICHAUD, and PAUL D. SARGENT.

P. ST. J. WILSON, chief engineer for the Office of Public Roads and Rural Engineering, will have charge of engineering work in connection with the expenditures under the Federal Aid Road Act of 1916. J. E. PENNYBACKER will have charge of all work other than engineering. The following district engineers have been appointed: district No. 1 comprising Washington, Oregon, and Idaho, L. I. HEWES, with headquarters at Portland; district No. 2, California, Nevada, Arizona, and New Mexico, C. H. SWEETSER, headquarters at Berkeley; district No. 3, Montana, Wyoming, Utah, and Colorado, J. A. WHITTAKER, with headquarters at Denver; district No. 4, North Dakota, South Dakota, Minnesota, and Wisconsin, E. O. HATHAWAY, headquarters at either St. Paul or Minneapolis; district No. 5 Nebraska, Iowa, Kansas, and Missouri, J. C. WONDERS, headquarters at either Omaha or Kansas City; district No. 6, Arkansas, Louisiana, Oklahoma, and Texas, J. D. FAUNTLEROY, headquarters at either Dallas or Fort Worth; district No. 7, Michigan, Illinois, Indiana, and Kentucky, J. T. VOSHELL, headquarters at South Chicago; district No. 8, Florida, Georgia, Alabama, Mississippi, South Carolina, and Tennessee, J. T. BULLEN, headquarters at either Montgomery or Birmingham; district No. 9, Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont, GUY H. MILLER, headquarters at Troy; district No. 10, Pennsylvania, Ohio, West Virginia, Virginia, Maryland, and North Carolina, H. K. BISHOP, headquarters at Washington.

Obituary

MICAJAH TERRILL BURGESS died November 22 at his home at Salt Lake City, Utah. He served under General Dodge during the construction of the Union Pacific railroad, and was chief engineer of the Utah lines during the construction of the Rio Grande Western railroad.

JOHN T. WILLIAMS, a prominent railroad engineer, whose work included the location and construction of parts of the main lines of the Western Pacific and Santa Fe railroads and the location of the Oakland, Antioch & Eastern railroad, died November 1, at Quincy, California, where he had been engaged in locating and constructing the Indian Valley railroad.

Commercial Paragraphs

The CHICAGO PNEUMATIC TOOL CO. has published Bulletin No. 150, an eight-page pamphlet on the lubrication of pneumatic tools.

The COAST CONSTRUCTION CO. of Los Angeles has assigned its contract for the construction of a sanitary-sewer system at Fresno, to S. N. CLARK of Los Angeles.

The RODNEY HUNT MACHINE CO., of Orange, Massachusetts, has published catalogue No. 30, describing the valves, gates, hoists, and other water-controlling apparatus manufactured by the company.

The BUCKEYE TRACTION DITCHER CO. has sold several trenching machines to the Delta Land & Water Co., Delta, the Millard County Drainage Association, Hinckley, and the Corinne Tile Drainage Co., Corinne, Utah.

The BUFFALO STEAM ROLLER CO. and the Kelly-Springfield Road Roller Co. have consolidated. The new company is known as the Buffalo-Springfield Road Roller Co. The main factory and home offices are at Springfield, Ohio.

The GENERAL ELECTRIC CO. has published Bulletin No. 46101-A, Type-P Demand Meters, Bulletin No. 46103-A, Type-M Demand Meters, Bulletin No. 46104-A, Type-G Demand Meters, and Bulletin No. 48320, Speed Regulating Rheostats and Panels for Direct Current Meters.

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Western Engineering

WEEKLY NEWS BULLETIN

WESTERN ENGINEERING *with* WEEKLY NEWS BULLETIN $4.50 per Year

SAN FRANCISCO, DECEMBER 4, 1916

SINGLE COPIES WEEKLY NEWS BULLETIN 15 Cents

Contracts Pending

Bids will be Received		See Issue of News Bulletin
Dec. 4.	Bisbee, Ariz., Miscellaneous	Dec. 4
Dec. 4.	Jackson Cal., Road Work	Nov. 27
Dec. 4.	Lewiston, Ida., Supplies	Dec. 4
Dec. 4.	Los Angeles, Cal., Machinery	Dec. 4
Dec. 4.	Los Angeles, Cal., Street Work	Dec. 4
Dec. 4.	Orofino, Ida., Street Work	Dec. 4
Dec. 4.	Richmond, Cal., Building	Nov. 27
Dec. 4.	Santa Barbara, Cal., Road Work	Nov. 27
Dec. 4.	Washington, D. C., Machinery	Dec. 4
Dec. 4.	Whittier, Cal., Supplies	Dec. 4
Dec. 5.	Berkeley, Cal., Street Work	Nov. 27
Dec. 5.	Calexico, Cal., Supplies	Dec. 4
Dec. 5.	Chico, Cal., Street Work	Dec. 4
Dec. 5.	Hanford, Cal., Bridge	Nov. 27
Dec. 5.	Merced, Cal., Bridge	Nov. 27
Dec. 5.	Modesto, Cal., Buildings	Nov. 20
Dec. 5.	Pasadena, Cal., Street Work	Dec. 4
Dec. 5.	Riverside, Cal., Sewer	Nov. 27
Dec. 5.	Salt Lake City, Utah, Building	Nov. 20
Dec. 5.	San Francisco, Cal., Street Work	Nov. 27
Dec. 5.	San Rafael, Cal., Road Work	Nov. 20
Dec. 5.	Stockton, Cal., Street Work	Nov. 20
Dec. 5.	Ventura, Cal., Bridges	Nov. 27
Dec. 5.	Ventura, Cal., River Work	Nov. 27
Dec. 5.	Ventura, Cal., Road Work	Nov. 27
Dec. 5.	Visalia, Cal., Bridges	Nov. 27
Dec. 5.	Washington, D. C., Machinery and Supplies	Nov. 13
Dec. 5.	Washington, D. C., Supplies	Nov. 27
Dec. 6.	Atascadero, Cal., Street Work	Nov. 27
Dec. 6.	Bakersfield, Cal., Road Work	Nov. 27
Dec. 6.	Mt. Vernon, Wash., Street Work	Dec. 4
Dec. 6.	Pittsburg, Cal., Sewers	Dec. 4
Dec. 6.	Portland, Ore., Bridge	Sept. 25
Dec. 6.	Santa Ana, Cal., Street Work	Nov. 27
Dec. 6.	Washington, D. C., Building	Oct. 23
Dec. 7.	Oakland, Cal., Sewer	Dec. 4
Dec. 7.	Portland, Ore., Machinery	Dec. 4
Dec. 7.	Santa Barbara, Cal., Sewer	Dec. 4
Dec. 8.	Redwood City, Cal., Culverts	Dec. 4
Dec. 8.	Redwood City, Cal., Road Work	Dec. 4
Dec. 8.	Oroville, Cal., Road Work	Nov. 27
Dec. 9.	Ventura, Cal., Culvert	Nov. 27
Dec. 11.	Asotin, Wash., Road Work	Nov. 27
Dec. 11.	Everett, Wash., Water Supply	Nov. 27
Dec. 11.	Los Angeles, Cal., River Work	Dec. 4
Dec. 11.	San Francisco, Cal., Supplies	Dec. 4
Dec. 11.	Washington, D. C., Machinery	Nov. 20
Dec. 12.	Denver, Colo., Supplies	Nov. 13
Dec. 12.	Los Angeles, Cal., Supplies	Dec. 4
Dec. 12.	Pasadena, Cal., Street Work	Nov. 27
Dec. 12.	Seattle, Wash., Bridge	Nov. 27
Dec. 13.	Napa, Cal., Road Work	Dec. 4
Dec. 13.	Portland, Ore., Sewer	Dec. 4
Dec. 15.	Los Angeles, Cal., River Work	Nov. 27
Dec. 15.	Ventura, Cal., Road Work	Dec. 4
Dec. 15.	Washington, D. C., Supplies	Dec. 4
Dec. 18.	Ketchikan, Alaska, Supplies	Nov. 20
Dec. 18.	Oakland, Cal., Bridge	Dec. 4
Dec. 18.	Washington, D. C., Miscellaneous	Nov. 27
Dec. 19.	Modesto, Cal., Building	Nov. 27
Dec. 19.	Seattle, Wash., Harbor Work	Dec. 4
Dec. 19.	Tracy, Cal., Irrigation	Dec. 4
Dec. 19.	Waterford, Cal., Irrigation	Nov. 27
Dec. 19.	Waterford, Cal., Irrigation	Dec. 4
Dec. 20.	Butte, Mont., Street Work	Dec. 4
Dec. 20.	Denver, Colo., Supplies	Dec. 4
Dec. 20.	Washington, D. C., Bridge	Dec. 4
Dec. 21.	Waterford, Cal., Irrigation	Dec. 4
Dec. 22.	Sacramento, Cal., Supplies	Dec. 4
Dec. 22.	Washington, D. C., Building	Dec. 4
Dec. 26.	Washington, D. C., Supplies	Nov. 27
Dec. 26.	Washington, D. C., Supplies	Dec. 4
Dec. 27.	San Francisco, Cal., Harbor Work	Dec. 4
Jan. 1.	Salt Lake City, Utah, Sewer	Nov. 27

Building Permits

In SAN FRANCISCO; $2500 and over in valuation.

NOVEMBER 23

Two Story Frame Dwelling—Cost $4000. S. A. Born Building Co., owner. Lot 2, Lincoln Manor.

Two Story Frame Dwelling—Cost $4000. S. A. Born Building Co., owner. Lot 22, Lincoln Manor.

Two Story Frame Dwelling—Cost $4000. S. A. Born Building Co., owner. Lot 23, Lincoln Manor.

Two Story Frame Dwelling—Cost $3500. S. A. Born Building Co., owner. Lot 19, Lincoln Manor.

Two Story Frame Flats—Cost $6223. Miss D. A. Hannah, owner. S Lincoln Way 65 E 12th Ave.

Two Story Frame Flats—Cost $6000. V. L. Sutherland, owner. W Church 61 S Cumberland.

Two Story Frame Dwelling—Cost $2500. Mrs. J. Kyle, owner. W Lower Terrace 500 S 17th.

Three Story Frame Tenements—Cost $20,000. L. B. Ham, owner. SE Lake and 20th Ave.

One Story Frame Dwelling—Cost $2600. F. and W. Smith, owners. N Southwood Drive 173 W Mirmar.

One Story Frame Dwelling—Cost $2600. F. and W. Smith, owners. N Southwood Drive 278 W Mirmar.

Dwelling Alterations—Cost $6800. Dr. A. R. Fritschi, owner. 2550 Broadway.

Two Story Frame Flats—Cost $5000. H. C. Keenan, owner. W 18th Ave 25 N Anza.

Two Story Frame Flats—Cost $5000. H. C. Keenan, owner. W 18th Ave 50 N Anza.

Two Story Frame Flats—Cost $5000. H. C. Keenan, owner. W 18th Ave 75 N Anza.

(Continued on Page 488)

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Construction News

STREET AND ROAD WORK

Albany, Cal.—Election has been called for December 9 to vote on bond issue of $25,000 for paving San Pablo avenue through city limits.

Bakersfield, Cal.—Contract for paving three blocks on 21st street has been awarded to Corfield & Davis for $6379.

Following were the unit prices named by Corfield & Davis, who were awarded contract for improvement of 21st street: grading and construction of asphalt and screening pavement of concrete base, $0.132 per sq. ft.; concrete gutters, $0.15 per sq. ft.; concrete curb, $0.30 per foot.

Butte, Mont.—Bids will be received until December 20 by A. A. Dockstader, city clerk, for improvement of Montana street.

Chico, Cal.—Bids will be received until 8 p. m., December 5, by Ira R. Morrison, city clerk, for paving part of Broadway street.

Everett, Wash.—Contract for paving highway No. 30 has been awarded to Mark Odell, Arcade Bdg., Seattle, for $108,000.

La Honda, Cal.—Construction of concrete pavement on several streets has been proposed. Charles Cavalli is interested.

Long Beach, Cal.—Contract for construction of six blocks of warrenite pavement on 6th street has been awarded to Fairchild-Gilmore-Wilton Co., Pacific Electric Bdg., Los Angeles.

Los Angeles, Cal.—Board of Public Works will receive bids until December 4 for the following street work: bitulithic pavement and concrete curbs and sidewalks on 7th street; concrete pavement, curbs, and gutters on Agatha street.

Contract for improvement of Pembroke lane has been awarded to Fairchild-Gilmore-Wilton Co. for $4376.21.

Contract for improvement of Angelus avenue has been awarded to B. Crites, 129 South Rio street, for $4047.61.

Los Angeles Paving Co. was low bidder at $34,594.11 for improvement of Eighth street. Engineer's estimate was $31,267.53. All bids were rejected because too high and work will be readvertised.

Martinez, Cal.—Contract for improvement of Pine, Susana, and Escobar streets has been awarded to O'Brien Bros. at the following unit prices: excavation, $0.60 per cu. yd.; redwood curbs, $0.12 per ft.; concrete sidewalks, $0.13 per square foot.

Contract for improvement of Court street has been awarded to O'Brien Bros. at $0.50 per cu. yd. for excavation, other prices the same as for the preceding job.

Marysville, Cal.—Contract for construction of ¾ mile of highway on Oroville road has been awarded to M. Blumenkranz, Lincoln, for $1965.

Mt. Vernon, Wash.—Bids will be received until December 6 by E. Crookston, city clerk, for construction of 6-in. concrete pavement on 4th street, and for clearing, grubbing, grading, and graveling on Highland avenue.

Napa, Cal.—Bids will be received until 10 a.m., December 13, by N. W. Collins, county clerk, for construction of highway in Mt. Veeder permanent road division. Separate bids will be received for grading and for furnishing crushed rock.

Orofino, Ida.—Bids will be received until December 4 by W. B. Kinne, town clerk, for construction of 3000 sq. yd. of concrete pavement.

Pasadena, Cal.—Date of opening bids for construction of 48,900 sq. ft. of concrete pavement on Madison avenue has been postponed to December 5. H. Dyer is city clerk.

Pomona, Cal.—Bond issue of $200,000 for construction of pavement, curbs, and storm-water drains is proposed.

Redwood City, Cal.—Bids will be received until December 8 by J. H. Nash, county clerk, for surfacing 28,200 sq. yd. of highway in road district No. 1.

Richmond, Cal.—Contract for improvement of Fourth street has been awarded to W. J. Johnson for $2524.03. Other bidders were: Fallon Construction Co. (bid irregular), $2415; S. C. Rogers, $2552.48; John Word, $2646.60.

Sacramento, Cal.—Bids will be received until 11 a.m., December 5, by M. J. Desmond, city clerk, for grading and construction of asphaltic macadam pavement for one block on alley between J and K streets.

San Diego, Cal.—Contract for improvement of 8th street has been awarded to Fairchild-Gilmore-Wilton Co., Pacific Electric Bdg., Los Angeles, for $5827.49.

San Francisco, Cal.—Contract for construction of 15,000 sq. ft.. of asphalt pavement and 600 lin. ft. of concrete curb on Oakdale avenue has been awarded to Flinn & Treacy Construction Co., First National Bank Bdg., at 65c. per lin. ft. for curb and 19c. per sq. ft. for pavement.

Contract for improvement of Phelan avenue and Ocean avenue has been awarded to Blanchard-Brown Co., 660 Market street, for $19,263.40.

Contract for improvement of Academy street has been awarded to the State Improvement Co., Crocker Bdg., for $3696.70.

Contract for improvement of Arthur avenue has been awarded to the City Street Improvement Co., 166 Geary street, for $15,080.38.

Contract for improvement of Evans avenue has been awarded to Karl Ehrhart, 660 Market street, for $52,593.81.

Contract for improvement of York street has been awarded to J. J. McHugh, 2289 Sutter street, for $2535.

Contract for improvement of Danvers street has been awarded to Flinn & Treacy, 404 First National Bank Bdg., for $2346.85.

Contract for improvement of Mariposa street has been awarded to J. J. McHugh for $4889.

Following bids were received for improvement of Clayton street: Federal Construction Co., $16,946; Ransome-Crummey Co., $18,015.40.

Sanger, Cal.—City engineer R. C. Phillips is preparing plans for curbing, grading, and oiling 4½ miles of streets.

San Jacinto, Cal.—Bond issue of $28,000 for street improvements has been voted.

Santa Barbara, Cal.—Contract for construction of asphaltic concrete pavement on Santa Barbara street and Pueblo street has been awarded to Municipal Improvement Co., Richmond, for $10,851.

Contract for construction of asphalt pavement on concrete base on several streets has been awarded to Municipal Improvement Co. for $12,633.96.

Contract for construction of asphaltic concrete pavement on several streets has been awarded to Municipal Improvement Co., Richmond, for $9223.17.

Santa Cruz, Cal.—Contract for improvement of King street has been awarded to A. P. Brady, Humboldt Bank Bdg., San Francisco, for $54,316.98. Other bidders were: Federal Construction Co., $54,738.62; City Street Improvement Co., $59,755.92.

Santa Paula, Cal.—Contract for improvement of several streets has been awarded to Fairchild-Gilmore-Wilton Co., Pacific Electric Bdg., Los Angeles, at the following unit prices: warrenite surface on concrete base, $0.14 per sq. ft.; concrete pavement without surface, $0.10 per sq. ft.; concrete sidewalks, $0.12 per sq. ft.; concrete gutters, $0.16 per sq. ft.; concrete curbs, $0.35 per ft.; a total of $25,000.

Ventura, Cal.—Bids will be received until 11:30 a.m., December 15, by J. B. McCloskey, county clerk, for construction of Somis-Moorpark highway, 7.42 miles. Work includes 23,170 cu. yd. excavation, 39,187 lin. ft. shaping road-bed, 196 cu. yd. concrete in bridges and culverts, 7756 cu. yd. concrete in pavement, 130 ft. 18 and 30-in. corrugated pipe, and 12,900 lb. reinforcing steel. Plans from County Highway Commission upon deposit of $3.

Washington, D. C.—Secretary of War has approved appropriation of $750,000 for roads and bridges in Alaska. This includes $100,000 for the first of three units of a steel bridge over the channel between Douglas island and Juneau. W. P. Richardson, Valdez, Alaska, is president of Alaska Road Commission.

Whittier, Cal.—Contract for construction of oil-macadam pavement on Bright avenue has been awarded to Municipal Improvement Co., Richmond.

SEWERS AND DRAINAGE

Bakersfield, Cal.—Contract for construction of vitrified-pipe sewers in district No. 34 has been awarded to L. S. Stroud for $1566.45, at the following unit prices: 6-in. vitrified-pipe sewer, $0.49 per ft.; manholes, $45 each; lampholes, $5 each.

Oakland, Cal.—Bids will be received until noon, December 7,

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by L. W. Cummings, city clerk, for construction of 8-in. vitrified pipe sewer on Fallon street.

Pittsburg, Cal.—Bids will be received until 8 p.m., December 6, by James Fitzgerald, city clerk, for construction of 4-in. and 10-in. sewers on several streets.

Portland, Ore.—City council will receive bids until December 13 for construction of Tanner Creek sewer. Estimated cost is $250,000.

Santa Ana, Cal.—Construction of outfall sewer is proposed. Estimated cost is $60,000.

Santa Barbara, Cal—Bids will be received until December 7 by A. C. Holmberg, city clerk, for construction of 8-in. vitrified-pipe sewer on Rancheria street.

Seal Beach, Cal.—Election has been called for December 21 to vote on bond issue of $45,000 for construction of sewer system, including septic tanks. Olmsted & Gillelen, Hollingsworth Bdg., Los Angeles, are engineers.

Woodland, Cal.—B. F. Conaway, Colonial Trust Bdg., Los Angeles, and associates have purchased 14,000 acres of land in this vicinity and will construct drainage and irrigation system.

BRIDGES AND CULVERTS

Colusa, Cal.—Supervisor R. Rahm has been authorized to construct concrete bridge at Rocky point as an emergency measure.

Supervisor C. J. Westcott has been authorized to construct concrete bridge near Kilgore place as an emergency measure.

Oakland, Cal.—Bids will be received until 10 a.m., December 18, by George E. Gross, county clerk, for construction of fender-piles at Webster street bridge.

Oroville, Cal.—O. A. Peters has been awarded the contract for construction of two bridges over Cottonwood creek for $2170. Other bidders were: Paulhon & Wink, $2170; T. H. Polk, $2288; E. B. Sharp, $2540.

Redwood City, Cal.—Bids will be received until December 8 by J. H. Nash, county clerk, for construction of two concrete culverts near Belmont.

Bids will be received until December 8 by J. H. Nash, county clerk, for construction of reinforced concrete culvert on Alpine road.

Washington, D. C.—Bids will be received until 2 p.m., December 20, at office of U. S. Reclamation Service, for furnishing and erecting a steel highway bridge consisting of four 41 ft. 6 in. pony-truss spans over the spillway at Sherburne Lake dam, Milk River project, Montana. Particulars from U. S. Reclamation Service, Washington, D. C., Denver, Colorado, or Browning, Montana.

IRRIGATION AND WATER SUPPLY

Medford, Ore.—Election has been called for December 27 to vote on organization of irrigation district containing 27,000 acres of land in this vicinity.

Modesto, Cal.—Contract for constructon of two reinforced concrete drops on lateral No. 3 of Modesto irrigation district has been awarded to H. E. Heller, Modesto, for $3363.04. Other bidders were: Tieslau Bros., $3559.70; Parlier & Green, $3637.50; C. A. Bruce, $3805.25; George J. Ulrich, $4115.30; C. Holm, $4123; M. Blumenkranz, $4147.45.

Contract for construction of concrete lining on 900 ft. of main canal has been awarded to James Willison, Redding, for $5540. Other bidders were: Tieslau Bros., $6487.50; Parlier & Green, $6950.

Oakland, Cal.—Property of Peoples Water Co. has been sold to reorganization committee for $12,697,400. New company will be known as East Bay Water Company.

Salt Lake City, Utah.—Brigham City Conservation Co. has applied for permission to divert 1000 second-feet of water from north fork of Ogden river. Plans include storage-reservoir and canal several miles long. C. B. Felt, Salt Lake City, is president.

San Diego, Cal.—Because of technicalities the bond issue of $682,000 for construction of concrete dam at Lower Otay site may not have been successful. In that case it will be necessary to call another election.

San Rafael, Cal.—Contract for construction of Pine Mountain tunnel for Marin Municipal Water District has been awarded to McLeran & Peterson, Sharon Bdg., San Francisco, for $257,400. Superintendent for Marin Municipal Water District has been directed to purchase 11,000 ft. of 6-in. iron water pipe.

Seal Beach, Cal.—Election has been called for December 21 to vote on bond issue of $30,000 for construction of water system. Water will be obtained from wells.

Tracy, Cal.—Bids will be received until 10 a.m., December 19, by W. Von Soster, secretary West Side irrigation district, for construction of intake canal 5500 ft. long at Bethany Ferry. Work includes 225,000 cu. yd. earth excavation. Hunter Morton, Commercial Savings Bank Bdg., Stockton, are engineers.

Waterford, Cal.—Bids will be received until 2 p.m., December 21, by C. C. Horsley, secretary Waterford irrigation district, for construction of excavation, backfilling, and 105 cu. yd. of reinforced concrete.

Bids will be received until the same time for construction of cement-plaster flume. Flume box is to be 4 by 6 ft., and approximately 900 ft. long.

Plans and specifications for the construction of sections No. 1 and 2 of the system of the Waterford irrigation district, bids for which are to be received until 10 a.m., December 19, by C. C. Horsley, secretary of district, are on file at office of Western Engineering. Work includes 45,000 cu. yd. excavation, mostly hardpan, 2200 lin. ft. of 8-ft. circular tunnel, and 9800 cu. yd. portal excavation. Timbering will probably not be necessary. Work is 14 miles east of Waterford.

LIGHT, HEAT, AND POWER

Los Angeles, Cal.—Contract for construction of ornamental lighting-system on West Adams street has been awarded to John L. Wilson for $3565.

City has offered to purchase distribution system within city of Pacific Light & Power Co. and Southern California Edison Co. for $9,415,000.

Terra Bella, Cal.—Contract for construction of power-lines, transformer-stations, etc., for Terra Bella irrigation district has been awarded to City Electric Supply Co., Riverside, for $44,400.

RIVER AND HARBOR WORK

Los Angeles, Cal.—Bids will be received until December 11 by J. W. Reagan, 348 Court House, for construction of earth levees on both sides of San Gabriel river for 14,000 lin. ft. near Artesia. Estimated cost is $8000.

Richmond, Cal.—Following bids were received for construction of 4600 lin. ft. of bulkhead at inner harbor: Standard American Dredging Co., 414 13th street, Oakland, $8.56 per ft.; San Francisco Bridge Co., $9.40; American Dredging Co., $11.50. Bids were taken under advisement.

Sacramento, Cal.—Surveys have been commenced for proposed ship canal from Sacramento to Suisun bay. Chamber of Commerce is interested.

San Francisco, Cal.—Bids will be received until 11 a.m., December 27, at U. S. Engineer Office, 401 Custom House, for dredging Oakland harbor. Information on application.

Seattle, Wash.—County commissioners will receive bids until 11 a.m., December 19, for construction of Lake Union wharf. Plans from Byron Phelps, clerk of board, upon deposit of $5.

RAILROAD WORK

Klamath Falls, Ore.—City engineer has been instructed to prepare plans for railroad from Klamath Falls to Sprague river. Estimated cost is $300,000. This project is in connection with proposed Oregon, California & Eastern railroad.

Santa Ana, Cal.—Salt Lake Route has completed plans for construction of railroad from Pico to Santa Ana, 25 miles.

Sandpoint, Ida.—Contract for construction of logging railroads for Idaho Match Block Co. has been awarded to G. A. Carlson, Spokane, Washington.

BUILDING CONSTRUCTION

Kingman, Ariz.—Contract for construction of reinforced concrete building for high school has been awarded to Edwards & Wildey Co., 515 Black Bdg., Los Angeles, for $46,750.

Manteca, Cal.—Spreckels Sugar Co. will construct sugar refinery.

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Marysville, Cal.—Contract for construction of school building has been awarded to I. C. Evans, Marysville, for $18,000.

Midvale, Utah.—Utah Iron & Steel Co. will construct addition to mills. Estimated cost is $60,000.

Monrovia, Cal.—Bond issue of $30,000 for construction of school building has been voted.

Red Bluff, Cal.—Grand Jury has recommended bond issue of 0,000 for construction of courthouse.

lt Lake City, Utah.—Contract for construction of building liberty school has been awarded to Con West for $20,878. act for heating and ventilating system has been awarded W. Spencer & Co. for $9998.

Bernardino, Cal.—Atchison, Topeko & Santa Fe Railroad paring plans for new passenger station and other buildings. Estimated cost is $500,000.

Stanford University, Cal.—Contract for construction of library building at University has been awarded to P. J. Walker Co., Monadnock Bdg., San Francisco, for $500,000.

Vallejo, Cal.—Contract for construction of reinforced concrete buildings for Sperry Flour Co. has been awarded to Dinwiddie Construction Co., Crocker Bdg., San Francisco, for about $500,000.

Washington, D. C.—Bids will be received until 3 p.m., December 22, at office of Supervising Architect, Treasury Department, for construction of post-office at Bakersfield, California. Plans from Superv ng Architect, or from custodian of site at Bakersfield.

MACHINERY AND SUPPLIES

Calexico, Cal.—Bids will be received until 5 p.m., December 5, by F. P. Green, city clerk, for furnishing about 2000 ft. of 4 to 10-in. cast-iron pipe and fittings.

Denver, Colo.—Bids will be received until December 20 at office of U. S. Reclamation Service, for furnishing cast-iron gates and gate-stands for Rio Grande project, New Mexico-Texas. About 12 tons of metal will be required. Particulars from U. S. Reclamation Service, Washington, D. C., Denver, or El Paso, Texas.

Eureka, Cal.—Contract for furnishing 12,000 ft. of 2-in. black spellerized pipe has been awarded to Pacific Hardware & Steel Co., San Francisco, for $13.93 per 100 pounds.

Glendale, Cal.—Contract for furnishing 4500 lb. of No. 6 and 8 copper wire to city has been awarded to U. S. Steel Products Co. for $38.28 per 100 pounds.

Lewiston, Ida.—City council will receive bids until December 4 for furnishing 8000 cu. yd. of crushed rock.

Los Angeles, Cal.—Bids will be received until 10 a.m., December 4, by H. B. Ferris, secretary Board of Public Works, for furnishing a steam-hammer.

Bids will be received until 4 p.m., December 12, by J. P. Vroman, secretary Department of Public Service, for furnishing weather-proof copper cables.

Portland, Ore.—Bids will be received until 3 p.m., December 7, by R. H. Thomas, school clerk, 401 Courthouse, for furnishing steam-engine for Benson polytechnic school. Specifications from F. A. Naramore, 303 Courthouse, upon deposit of $1.

Sacramento, Cal.—Following bids have been received for furnishing fire apparatus to city: American La France Co., $9200 for two motor-driven hose-wagons and $7000 for combination hose-wagon and pumping engine; Seagrave Co., $10,900 for the hose-wagons and $5750 for the combination outfit, with a reduction of 10% on the total bid in case the contract for all three pieces of apparatus is awarded to it.

Bids will be received until 2 p.m., December 22, by E. F. Pfund, county clerk, for furnishing and installing boiler and piping at county hospital.

San Francisco, Cal.—Bids will be received until December 11 by John T. Knight, colonel quartermaster corps, Fort Mason, for furnishing 482 steel boiler tubes.

Sumner, Wash.—Bids are being received by city clerk for furnishing motor-driven fire-truck. Estimated cost is $2500.

Washington, D. C.—Bureau of Yards and Docks, Navy Department, will receive bids until December 4 for furnishing two fitting-out cranes at Mare Island, California.

Bids will be received until 10:30 a.m., December 15, by General Purchasing Agent, Panama Canal, for furnishing centrifugal pumps and equipment, steel pinions, pipe fittings, screws, rivets, bolts, and belt lacing.

Bids will be received until December 26 at office of U. S. Reclamation Service, for furnishing nine pairs of cast-iron skew-bevel gears for gate-stands for Rio Grande project, Texas-New Mexico. Particulars from U. S. Reclamation Service.

Whittier, Cal.—Bids will be received until December 4 by C. O. Trueblood, city clerk, for furnishing about two miles of 4 to 10-in. cast-iron pipe and fittings.

MISCELLANEOUS

Bisbee, Ariz.—Bids will be received until 7 p.m., December 4, by M. L. Butler, city clerk, for construction of fire-alarm telegraph system.

Washington, D. C.—Contract for construction of two destroyers has been awarded to Mare Island Navy Yard for $968,105 each.

BUILDING PERMITS

(Continued from Page 485)

Two Story Frame Dwelling—Cost $3000. A. Harrington, owner. W 26th Ave 25 N Cabrillo.
Two Story Frame Dwelling—Cost $3000. A. Harrington, owner. W 26th Ave 50 N Cabrillo.
Two Story Frame Dwelling—Cost $3000. A. Harrington, owner. W 26th Ave 75 N Cabrillo.
Two Story Frame Dwelling—Cost $3000. A. Harrington, owner. W 26th Ave 100 N Cabrillo.

NOVEMBER 24

Two Story Frame Dwelling—Cost $2500. W. J. Keenan, owner. W Atalaya Terrace 41 N Fulton.
Two Story Frame Dwelling—Cost $2500. W. J. Keenan, owner. W Atalaya Terrace 70 N Fulton.
Two Story Frame Dwelling—Cost $2500. W. J. Keenan, owner. W Atalaya Terrace 100 N Fulton.
Two Story Frame Dwelling—Cost $2500. W. J. Keenan, owner. W Atalaya Terrace 120 N Fulton.

NOVEMBER 25

Two Story Frame Dwelling—Cost $26,000. James E. Walsh, owner. NW Broadway and Buchanan.
Two Story Frame Dwelling—Cost $2500. F. Nelson, owner. E Arguello Blvd 69 S Carl.
Two Story Frame Dwelling—Cost $2500. F. Nelson, owner. E Arguello Blvd 142 N Parnassus.
Two Story Frame Dwelling—Cost $2500. F. Nelson, owner. W 29th Ave 275 S Lincoln Way.
Two Story Frame Dwelling—Cost $3000. C. A. Hall, owner. W 10th Ave 25 S Balboa.

NOVEMBER 27

Two Story Frame Dwelling—Cost $2900. A. T. Morris, owner. W 11th Ave 200 S Anza.
Two Story Frame Dwelling—Cost $3000. J. M. Peters, owner. W 12th Ave 150 S Cabrillo.
Two Story Frame Dwelling—Cost $3000. J. M. Peters, owner. W 12th Ave 175 S Cabrillo.
Three Story Frame Residence—Cost $22,399. K. Theriot, owner. SE Gough and Washington.
Three Story Frame Stores and Tenements—Cost $14,000. W. G. Hind, owner. W 6th 75 N Bryant.
Bakery Alterations—Cost $2860. Ferro Bros., owners. S 23rd 25 W York.
Two Story Frame Dwelling—Cost $2500. Thos. Hamill, owner. SW Balboa and 42nd Ave.

NOVEMBER 28

Shore and Underpin Warehouse—Cost $2500. John Martin, owner. S Stevenson 167-6 W First.
Two Story Frame Dwelling—Cost $3000. Costello & Feerick, owners. E 17th Ave 125 N Balboa.
Two Story Frame Dwelling—Cost $3000. Costello & Feerick, owners. E 17th Ave 150 N Balboa.

NOVEMBER 29

Flat Alterations and Additions—Cost $3750. Wm. Crocker, owner. NW Divisadero and Fulton.
Two Story Frame Dwelling—Cost $10,000. Thos. Scoble, owner. Lot 31, Sea Cliff.
Two Story Frame Dwelling—Cost $10,000. Thos. Scoble, owner. Lot 32, Sea Cliff.
Two Story Frame Flats—Cost $3300. E. G. Brugge, owner. NE Anza and 5th Ave.
Store and Flat Alterations—Cost $2938. J. Friedman, owner. 1122 McAllister.
Two Story Frame Flats—Cost $4000. Jos. Hagan, owner. N Sacramento 100 W Polk.

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